DOCUMENT RESUME

ED 076 773 VT 020 108

AUTHOR	Cooper, Arnold C.
TITLE	The Founding of Technologically-Based Firms.
INSTITUTION	Center for Venture Management, Milwaukee, Wis.
PUB DATE	71
NOTE	68p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Administrative Personnel; Administrator Background; *Administrator Characteristics; *Business Administration; Engineering; Individual Power; *Management; Organizational Change; Research and Development Centers; Scientific Enterprise; *Technological Advancement; Technology
IDENTIFIERS	*Entrepreneurs

ABSTRACT

This monograph describes a study of entrepreneurship in new technologically-based firms. The work is based on empirical data gathered primarily in interviews with individuals who formed such enterprises. Most of the research was conducted in one of the nation's centers of technological entrepreneurship, the San Francisco Peninsula area around Palo Alto, California. Focus is on the founding of new technologically-based firms. Such new companies are rare, and the study examines the factors that create an environment in which an entrepreneur may take the step of starting his own firm. Spin-offs from established organizations appear to function as incubators to a great extent. One of the most important factors is the development of markets and technologies on which the area's industry is based. But the individual entrepreneur, his background and characteristics, is the paramount influence. The monograph concludes with implications for established firms, implications for prospective entrepreneurs, and implications for regional economic development of factors favorable to technical entrepreneurship. (MF)

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THE FOUNDING OF TECHNOLOGICALLY-BASED FIRMS

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ACKNOWLEDGEMENTS

Many people have contributed to this effort. Among the foremost are the founders of the new, technologically-based firms on the San Francisco Peninsula. Because this work is based upon empirical data, gathered primarily in interviews, the assistance of these very busy men was essential. Without their willing cooperation, this research could not have been done.

Dr. John Komives and The Center For Venture Management provided vital support and encouragement. During the summer of 1969, The Center supported this work and enabled me to spend the summer in Palo Alto gathering data. Subsequently, Dr. Komives urged me to write this monograph for publication by The Center For Venture Management.

During the academic year, 1967-1968, while a visiting professor at Stanford University, I became deeply interested in the process by which new, technologically-based firms are founded. The deans and faculty of The Graduate School of Business at Stanford extended many kindnesses to me during that year, as well as during the summer of 1969 when I returned to pursue this research further.

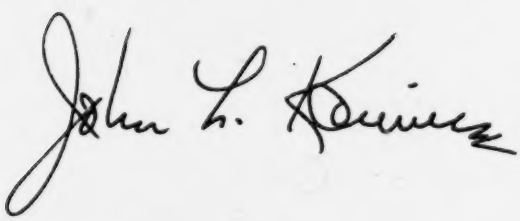
My colleagues, Associate Dean Rene P. Manes and Professor Robert W. Johnson reviewed the manuscript and made helpful comments, as did Dr. Komives of The Center For Venture Management. My appreciation is also extended to Dean John S. Day for his continuing support.

Typing was done y Mrs. Rebecca Phillippo, Miss Evelyn Swartz, and particularly by Mrs. Elizabeth Tisley.

PREFACE

It is indeed a great pleasure for The Center for Venture Management to publish and make available this study and thus add to the growing literature on technical entrepreneurship. It is only when we understand the well-springs of enterprise will we, as a Nation fully understand the essence of free enterprise. At its core, free enterprise relies on the motives and actions of a single individual or small group of individuals acting in concert to bring about the formation of a new firm. This study delves into the background and work experiences of a group of highly trained persons who then went about the business of forming a new, high-technology enterprise.

We take this opportunity to thank Dr. Cooper for his efforts in completing this study, which was the first major research activity undertaken by the newly formed Center for Venture Management. And we hope that this study will be read and used by scholars of enterprise and induce them too, to undertake further research into this fascinating field.



John L. Komives

TABLE OF CONTENTS

CHAPTER I

Introduction 1

CHAPTER II

Definitions Used And The Nature of The Research 4

CHAPTER III

A Framework For Analysis And Characteristics of the Entrepreneur 9

CHAPTER IV

Incubator Organizations 18

CHAPTER V

Spin-Off Rates From Established Organizations 26

CHAPTER VI

Regional Differences in Technical Entrepreneurship 36

CHAPTER VII

The Birth And Death of Firms Over Time 47

CHAPTER VIII

Conclusions And Implications 54

CHAPTER I

Introduction

In certain parts of our country, such as Boston, Palo Alto, and Los Angeles, large numbers of new, technologically-based firms have come into being in recent years. Business Week calls these firms "Xeroids" (Xerox plus Polaroid). Investors search for future "Xeroids," while regional development commissions dream of creating local versions of Boston's Route #128.

Many of these firms have been responsible for significant technological innovations. For instance, consider three companies formed in 1957: Digital Equipment, Raychem Corporation, and Fairchild Semi-conductor (a division of Fairchild Camera and Instrument). Digital Equipment pioneered in developing small computers; Raychem played a leading role in the development of irradiated plastics; Fairchild was a leader in the then infant semiconductor industry. By 1969, the sales of these firms were $87 million, $45 million, and $150 million respectively. The remarkable records of these three firms are by no means typical; many other new companies have enjoyed only modest success or have met with failure. Nevertheless, new, technologically-based firms (NTBF's), considered as a group, have had a significant economic and technological impact. They complement our existing industry by constituting hundreds of additional centers of innovation and initiative, searching for opportunities to match developing technologies and market needs. In fact, the "Panel on Invention and Innovation," convened by the Secretary of Commerce and made up principally of representatives of large firms, concluded:

> *"Independent inventors and small firms are responsible for an important part of our inventive process, a larger percentage than their relatively small investment in R & D would suggest."*[1]

Some individual engineers and technical managers function effectively in the large company environment; others do not. When new and small firms exist, there are alternatives for career fulfillment, and individuals can seek out those environments where they will be most fulfilled and productive.

From the standpoint of regional economic development, NTBF's are often viewed as highly desirable. They make pleasant neighbors, producing relatively little noise and pollution. They often employ substantial percentages of highly paid scientists and engineers. Since these are corporate headquarters, their professional employees are likely to be more committed to the community, thinking in terms of a lifetime involvement, rather than a two-year stay before the next move.

It is unlikely that any single company or management group can always be right in "betting" on future markets and technologies. However, a region whose growth and stability are tied to many independent centers of decision-making may be better able to respond flexibly in a rapidly changing environment. In relation

[1] Technological Innovation: Its Environment and Management, Washington, D. C.: U. S. Government Printing Office, 1967, p. 17.

to this, a Stanford Research Institute study of the development of "research complexes" concluded:

> *"All of the evidence in this series of studies suggests that attracting corporation divisions does not provide the most effective or desirable path to development. On the contrary, establishment of a number of small and medium size technical companies is the most effective way to provide for the development of a complex."*[2]

In their efforts to develop technologically-based industry, communities have often competed to attract branch laboratories or plants of national firms. In many instances, the efforts have met with frustration and the industrial parks are still empty. Sometimes a single large defense contractor has been attracted, but subsequent heavy community dependence upon the fluctuating fortunes of a dominant firm has proved to be a mixed blessing.

In contrast to all of the effort to attract firms from elsewhere, relatively little attention has been devoted to encouraging the birth and growth of new local firms. In part, this may be due to lack of understanding about how new firms are brought forth and nurtured.

The importance of new, technologically-based firms suggests that we need to learn more about how they come into being. This study is concerned with adding to our understanding about the birth of these firms. It develops a basis of factual data and a conceptual framework for understanding technical entrepreneurship. A number of major questions relating to entrepreneurship are considered:

1. What are the factors bearing upon the birth of NTBF's?
2. To what extent do entrepreneurs move to other geographical areas when founding their firms?
3. To what extent are NTBF's related in terms of technology and markets to the established organizations which the founders leave?
4. What motivates the founders?
5. In what ways do the established firms in an area influence entrepreneurship?
6. In an area of active entrepreneurship what are the spin-off rates from established organizations? Are there substantial variations?
7. Do average spin-off rates vary by type or size of established organization?
8. What factors bear upon differences in regional rates of technical entrepreneurship?
9. How does past entrepreneurship influence future entrepreneurship?
10. What are the roles of local sources of venture capital,

[2]K. Draheim, R. Howell, and A. Shapero. The Development of a Potential R & D Complex. Menlo Park, California: Stanford Research Institute, July, 1966, p. 9.

of universities, and of living conditions in influencing entrepreneurship?

11. In an entrepreneurially active area, what are the annual birth-rates of new firms? What are the survival rates of these firms?

These questions have implications for many groups, including executives of the established organizations from which entrepreneurs spin off, engineers or technical managers who envisage becoming entrepreneurs some day, and those concerned with regional economic development.

A word of warning. This is not a definitive and exhaustive study of all of the complex processes influencing technical entrepreneurship. This research is of limited scope, concentrating on certain aspects of the total process. It is an introductory study; most of the questions considered here have not been the subject of much previous research. Within these limitations, the objective here is to add to our understanding of entrepreneurship in general and technical entrepreneurship in particular.

CHAPTER II

Definitions Used And The Nature of The Research

What is a new, technologically-based firm? It is not easy to say when a firm comes into being, nor is it always easy to determine whether a particular company is "new." In an area of active entrepreneurship, there are companies and dreams of companies in many different stages of development. Some would-be entrepreneurs have developed plans to varying degrees of completeness, while continuing with their present jobs. Others, on a part-time basis, are designing products in their garages or doing consulting. Some have left their previous jobs and are devoting all of their time to trying to get new firms started. One will hear that "John Jones has quit Fairchild and is trying to raise capital for a new firm." Sometimes the company will "surface" a few weeks later with a newspaper announcement describing the founding group and the initial business address. In other instances, never publicized at the time, the aspiring founder meets with frustration and begins consulting or takes another job to support his family.

A hard-to-classify situation, for example, was a new semiconductor firm which virtually failed with its initial founders. New managers (or entrepreneurs?) came on the scene, bringing with them additional capital. Building upon the shell of what they found, they succeeded in getting the company off the ground. Under such circumstances, when was the company founded, or is one talking about the founding of two different firms?

Who are the founders of a new firm? In many instances, one or more men clearly occupy this role. In other situations, deciding who are the founders is difficult because key men make varying degrees of commitment or join the new firm at different stages of its development. For instance, one part-time business became a full-time venture with considerable promise after an outside investor gave not only funds, but also advice, encouragement, and assistance in raising money from others; yet, he limited his own involvement to a part-time commitment. Some founding groups will describe themselves as made up of "early founders" and "late founders." In one new firm, the "early founder" made a full-time commitment in April, concentrating on product development; he was joined in October by the "late founder," whose major contributions were to be in management and marketing.

The variety of situations described above demonstrates that definitions in this field must be somewhat arbitrary, and that some firms defy neat classification.

In this study, when a member of top management (usually the president) of the new firm was contacted, he was asked whom he considered to be the founders. If the men named had made a full-time commitment, they were counted as founders.

In regard to firms studied, this research concentrates solely upon businesses which had reached a stage of development in which

the full-time efforts of the founders were required; no "part-time" ventures were studied. The date-of-founding was defined as the time when at least one manager or scientist began to devote full-time to the business. If the prospective founder was initially unsuccessful in raising capital or putting together an entrepreneurial group and then intermittently pursued such efforts while consulting, the date-of-founding was counted as that time when a viable firm was finally launched. In the case of a business which was substantially boosted or revived by a second wave of founders, it was rather arbitrarily decided to count it as only one firm, with the focus being upon the "first" set of founders and the "first" founding date.

A technologically-based firm is defined as a company which emphasizes research and development or which places major emphasis on exploiting new technical knowledge. The typical firm studied had a "product" which was technical hardware or technical studies. Explicitly excluded from the study were firms offering only management consulting, computer software, or wholesaling and selling services. Also omitted were "sponsored spin-offs," in which a parent firm voluntarily established and held stock in a newly formed company intended to perform some of the business of the sponsoring firm.

THE RESEARCH

The research was conducted primarily in one of the nation's centers of technical entrepreneurship - the San Francisco Peninsula area around Palo Alto, California. The boundaries of the region studied are indicated on the map in Exhibit II-1. The study concentrated upon companies founded during the decade of the 1960's, specifically those founded between January 1, 1960, and July 1, 1969. Because of the industrial make-up of the Palo Alto area, these were principally firms operating in or associated with the electronics industry.

The first phase of the research involved intensive structured interviews with 30 entrepreneurs. The typical interview lasted about two hours and focused upon the events and decisions associated with the founding of the firm.

In the second phase, an attempt was made to gather summary data, chiefly through telephone interviews, relating to the founding of all of the NTBF's started on the San Francisco Peninsula since 1960. In total, data were gathered on the founding of about 220 additional new firms, bringing the total studied to approximately 250; this included a number of companies no longer in existence. As nearly as can be determined, these data represent most of the companies of this type started in the area since 1960, and may be regarded as a census of the population.

A third step involved interviews with executives from established organizations. Data were gathered about spin-offs from their firms and about internal factors which may have encouraged or discouraged entrepreneurship. The focus was upon those major organizations from which many entrepreneurs have come, or upon unique

Exhibit II-I

GEOGRAPHICAL AREA STUDIED

New firms studied were within the region bounded by dotted line

types of organizations such as universities and non-profit research organizations.

The companies studied do not represent a statistical sample of the population of NTBF's; they do represent an attempted census of the total population of these firms. When the research was started, the population of new firms which had been founded during the 1960's was not known, although there were knowledgeable observers who knew of many foundings. One product of this research is the development of a list of firms which were started - an itemization of the members of the population. Many of the companies studied no longer exist as independent firms, having since been discontinued or merged.

The initial approach to identifying NTBF's was to rely upon three sources: present and past membership of the Western Electronic Manufacturers Association, announcements in the business section of The Palo Alto Times, and present and past listings in the yellow pages of the telephone directories of the various cities in the region. These data were culled to eliminate firms founded before 1960, divisions of existing firms, or other companies not meeting the criteria described above. In most instances, a senior executive of the firm was contacted, either through telephone or personal interview. After information was gathered about the founding of that firm, the executive was then asked about spin-offs from his company or about spin-offs from the company for which he had previously worked. The process was continued, with each new firm mentioned being investigated, and with each new executive contacted being asked about other spin-offs. In some instances with firms long discontinued, it was possible to obtain only partial information, such as name of firm and probable date of founding.

To identify every new firm founded during the decade of the 1960's is probably an impossible task. The firms most likely to have been overlooked are those which were never very visible or successful. Possibly, they existed for only a short time, with the founders never arranging for any publicity or involvement with a trade association. Some data were gathered on a total of 13 "mystery firms" which were known to have existed and which were probably members of the population being studed; however, beyond that, nothing is known about them. They remain "mystery firms." In addition, some firms which were founded in the last few weeks of the 9½ year period under study probably were omitted because they had not yet become "visible" as of July 1, 1969, the cut-off date for the study. It might be added that all of the entrepreneurs contacted did cooperate to a marked degree; only in one company did the entrepreneur refuse to give any information.

CONCLUSION

In many parts of the country, when an engineer or technical manager quits his job, he then goes to work for another established organization. However, in the Palo Alto area during the decade of the 1960's, such a man sometimes founded a new, technolog-

ically-based firm. This research focuses upon this phenomenon, and is based upon data gathered in one of the few places where a high rate of technical entrepreneurship could be observed and studied.

Basically, there were three kinds of data-gathering activities. The first involved intensive interviews with individual entrepreneurs and was directed toward understanding how a new firm gets started. These interviews were far-ranging, focused primarily upon qualitative information, and had as one of their results the generation of ideas, propositions or hypotheses about the nature of the entrepreneurial process.

The second kind of activity was directed toward identifying and gathering data about the entire population of new firms, so that conclusions could be drawn about that population. The primary method utilized short, structured telephone interviews. The resulting data, considered in the aggregate, were more quantitative in nature, and could be counted, compared, and analyzed to test various hypotheses.

The third kind of data-gathering activity, less ambitious in scope than the first two, involved intensive interviews with managers of organizations which entrepreneurs had left. This resulted in a mixture of the kinds of information described above, with particular emphasis on the nature of the organizational influence upon the entrepreneur.

In the subsequent discussions and analyses, data from all three sources are drawn upon as they relate to particular aspects of entrepreneurship. Hopefully, the result is deeper understanding, utilizing both quantitative data about the entire population of new firms and qualitative interview data to help to explain the process at work.

CHAPTER III

A Framework For Analysis And Characteristics of the Entrepreneur

What are the events and decisions which lead to the founding of a particular firm? To what extent is the founding of one firm like that of another?

This chapter first presents brief descriptions of how two particular firms were founded. These illustrate how each founding is a unique event, yet also has elements in common with other foundings. Then, an analytical framework is presented for organizing and understanding the factors which influence the entrepreneurial decision. Finally, one of the major factors - the individual entrepreneur and his background - is examined.

COMPANY A

The marketing manager of a rapidly growing electronics firm in Palo Alto had, for several years, considered taking the step of starting his own firm. He had previously worked in engineering for two different firms in the East and then had worked in positions of increasing responsibility in sales for a West Coast firm which grew fifty-fold during his time with it. He then became head of marketing for a Palo Alto firm, and helped that company grow approximately forty-fold during the next few years.

While with the Palo Alto firm, he bagan to disagree with certain important decisions in regard to product development and the selection of key personnel. He said, "I saw myself on a collision path with the president, and knew that I would not stay with the company." In addition to his increasing dissatisfaction with his future in this firm, he had increasingly thought about taking the entrepreneurial step himself. In his own words, "I had finally gotten the bug. I thought I'd like to try it myself . . . to try to create something out of nothing . . . to try to make a company important in its field." In the past, he had considered with certain friends and colleagues a number of product- market opportunities which might be the basis for a new company; however, nothing had quite jelled. Finally, a specific opportunity came into focus, relating to the development of a particular component with technical capabilities exceeding anything then on the market.

In the fall of 1965, he and three other engineers from the same firm left the parent company and started on their own. They estimated that their own savings, including stock ownership, were sufficient to support the company for six to nine months. They believed that they easily could raise additional funds from five different men they knew, all of whom were technical executives who had invested in other new, technologically-based firms in the past. When they started, they had no product developed and had not specifically talked to any customers, yet . . . "We were tremendously confident . . . Even if we had to work 24 hours a day, we were determined to meet our goals."

COMPANY B

An engineer with a small electronics firm had previously worked for a large government laboratory and a large aerospace firm. In the government laboratory, he had found the atmosphere relaxed and suitable for a man dedicated to science, but not for a man ambitious economically. At the aerospace firm, there had been little real work for him to do; he participated in developing bids, but none of these bids was accepted during his short tenure with the company. He quit after a few months, and took a pay cut to join a small firm which advertised for an engineer.

Here, he had responsibility for a line of instruments; he either handled personally or supervised the bidding, designing, building, testing, and delivery of the instruments. He worked long hours and also enrolled in an evening M.B.A. program. During this time he felt increasing frustration about some of the organizational decisions which had been made, the technical help he was able to receive from others on the staff, and his compensation. He prepared a proposal which involved an expansion for his part of the business. The proposal was turned down, and he quit on the spot. He had not planned to quit; he had not planned to become an entrepreneur.

He made the decision to start a company specializing in the same kind of instruments he had been responsible for in his previous job. He tried to raise capital from a number of sources, but was successful only in raising a small amount of money from previous colleagues who planned to join him after the company got going. He bid on and succeeded in getting an order to deliver some technically advanced instruments. Subsequently, he discovered that he had inadequate funds to carry through on the order. Because of financial problems, he changed the strategy of the business and became a sub-contractor, primarily designing and producing particular components for one large local firm. He did not continue with the original conception of developing a line of instruments, but instead directed the company toward considerable growth and prosperity as a specialized sub-contractor.

A FRAMEWORK FOR ANALYSIS

Examination of the sequence of events and decisions described above suggests that the processes leading to the founding of a new firm are complex and that many factors exert an influence. Despite the complexity and diversity, there appear to be common processes at work, such that each founding is influenced by certain factors.

The decision to start a particular business at a particular time and place might be thought of as being influenced by three major factors, each of which has a number of sub-parts:

1. The entrepreneur himself, including the many aspects of his background which affect his motivations, his perceptions, and his skills and knowledge.

2. The established organization for which the entrepreneur had previously been working, which might be termed an "incubator organization." It hires and often brings the potential founder into an area; it trains him and helps him to develop technical, market, and managerial skills and knowledge; it provides the organizational framework which may allow the potential founder to work closely with men of varied skills who might join him in an entrepreneurial team. In addition, the established organization, through the satisfactions and frustrations it provides, helps to influence the motivations of the prospective entrepreneur.
3. Various external factors, many of them regional in nature. These include the availability of capital, accessibility to suppliers, personnel, and markets, and the collective attitudes and perceptions relating to entrepreneurship and the risks and rewards associated with it. Other external influences, more characteristic of the national economy than of a particular region, are the state of the economy and stock market conditions.

This research is concerned primarily with the role of the incubator organization and those external factors which may vary from region to region. The former is considered in Chapters IV and V and the latter in Chapter VI. Certain characteristics of the individual entrepreneur are discussed later in this chapter.

LIMITATIONS ON THE SCOPE OF THE STUDY

Two external factors, primarily national rather than regional in character, are not covered in this research. One is the state of the economy – including the overall demand for the goods or services which might be offered by a new firm. The other is stock market conditions, particularly attitudes toward "new issues" and speculative "glamor stocks." Both of these factors may vary substantially over time and, in fact, often follow cyclical patterns. Their influence may be such that it is much easier to start NTBF's in some years than in other years.

This study covers a limited period and does not permit an examination of the influence of widely differing rates of economic activity upon technical entrepreneurship. It has not involved the gathering of data about growth rates of particular industry sub-segments or measures of the availability of capital, data which could be useful in relating these factors to rates of entrepreneurship. Such extensions of this research are left until another time.

THE INDIVIDUAL ENTREPRENEUR

Under a given set of conditions, some will dream of entrepreneurship, some will find such thoughts to be foreign and unappealing, and a few will actually take the step of starting new firms. What characterize these rare individuals who are attracted or driven to entrepreneurship?

Roberts and Wainer have studied more than 200 technical entrepreneurs in the Boston area. They found that an unusually high percentage of technical entrepreneurs (50%) came from homes in which the father was self-employed, that the average education of founders studied was an M.S. degree plus some courses, and that the average age when starting the new company was 32.[1]

Industrial Research magazine published a study of science entrepreneurs in the Philadelphia area; 35 founders were interviewed. These entrepreneurs averaged 35 years of age when founding their firms, and 30 of 35 had college degrees, with nine having advanced degrees.[2]

Collins and Moore studied the founders of 110 manufacturing companies in Michigan; these were primarily not high-technology firms. In their sample, the median educational level was a high school diploma, two-thirds of the founders came from families described as "poor," an unusually high percentage (55%) were either foreign - born or first generation Americans, and a substantial percentage (25%) had fathers who were entrepreneurs. One of their interesting conclusions was that the typical entrepreneur finds it difficult to work for others and difficult to function in the hierarchies of established organizations.[3]

Hoad studied 95 manufacturing businesses started in Michigan during the year ending June 30, 1960; most of these firms were not technically oriented. Only 26 of the 95 firms had founders with bachelors degrees or above.[4]

THE INDIVIDUAL ENTREPRENEUR IN PALO ALTO

In this study, the 30 founders studied intensively in the Palo Alto area had a variety of backgrounds but the "typical" (median) founding group can be described as follows:

The firm is started by two founders, both of whom are in the middle thirties. One usually can be described as the "driving force." He conceives the idea and enlists the other founder. They come from the same established organization, and got to know each other there. One is in engineering development and the other is in marketing. Often, they have achieved significant prior success, with titles such as section head or director of engineering being common. Their education includes B.S. and M.S. degrees, typically in electrical engineering. Exhibits III-1 through III-5 give data in greater detail.

In general, the Palo Alto technical entrepreneurs seem comparable to those studied in Boston and Philadelphia with respect to those characteristics on which common data have been gathered: age and education.

There is a marked contrast with the non-technical entrepreneurs studied by Collins and Moore and also by Hoad in regard to education; clearly technical entrepreneurs are more highly educated than the founders of the typical manufacturing firm. This is not surprising, considering that much of the initial competitive

[1] E. B. Roberts and H. A. Wainer, "New Enterprises on Route 128," Science Journal, December 1968.

[2] _____, "The Science Entrepreneur," Industrial Research, February 1967.

[3] O. E. Collins and D. G. Moore, The Enterprising Man, East Lansing: Bureau of Business and Economic Research, Michigan State University, 1964.

[4] W. M. Hoad, Management Factors Contributing to the Success or Failure of New Small Manufacturers, Ann Arbor: Bureau of Business Research, Graduate School of Business Administration, University of Michigan, 1964.

Exhibit III-1

SIZE OF FOUNDING GROUP AND NUMBER
OF PARENT ORGANIZATIONS REPRESENTED

	Size of Founding Group						
Number of Parent Organizations	1	2	3	4	5	6 or more	Total
1	9	5	2	3	2	1	22
2		3	3				6
3					1		1
4				1			1
Total	9	8	5	4	3	1	30

mode = 1 founder

median = 2 founders

mean = 2.9 founders

Exhibit III-2

EDUCATION OF FOUNDERS*
HIGHEST DEGREE RECEIVED

No college degree	1
B. S. or B. A.	12
M. S.	6
M. B. A.	2
Ph. D.	8
M. D.	1
Total number of founders	30

*For firms with multiple founders, data are for that founder interviewed only. (In most instances, interviewee could be defined as the "driving force.")

Exhibit III-3
NUMBER OF PREVIOUS EMPLOYERS
PRIOR TO FOUNDING COMPANY*

Number of Previous Employers	1	2	3	4	5	6	Total
Number of Founders*	0	9	8	11	2	1	30

mode = 4 employers
median = 3 employers
mean = 3.4 employers

*Defined as full-time positions held since getting bachelor's degree and not including military service.

Exhibit III-4

PRIOR LEVEL OF RESPONSIBILITY OF FOUNDERS

	No Subordinates: Bench Engineer, Salesman, or Staff Analyst	Section or Project Leader	Policy-Making Level: Vice-President, Chief Engineer, Marketing Manager, President, etc.	Consultant	Total
Number of Founders	5	9	15	1	30

Exhibit III-5

MAJOR FUNCTIONAL RESPONSIBILITY OF FOUNDERS*

	Prior Position				
	Marketing	R & D	Manufacturing or Development & Manufacturing	General Management	Total
Number of Founders	5	9	6	10	30

*Note: Many of the founders were not easily classified. Those in small organizations or with product responsibility often had broad and shifting responsibilities.

strength of an NTBF is based upon the technical knowledge of its founders, knowledge often based upon advanced education.

There appears to be an interesting contrast with the Collins and Moore study. Based upon psychological tests and depth interviews relating to personal histories and career patterns, they concluded that founders of manufacturing firms had had life-long patterns of relating ineffectively to authority. They often came from homes where the father had died or was not respected. In school, their restlessness, refusal to accept routine, and inability to get along with teachers often led to an early departure. They had not found it easy to work for employers and had rarely stayed long with one firm. They were described as "men who have failed in the traditional and highly structured roles available to them in society."[5]

Founders of NTBF's may differ from the entrepreneurs studied by Collins and Moore in regard to these basic psychological attitudes. Detailed childhood histories and psychological test results are not not available for these technical entrepreneurs.[6] However, data on educational and career backgrounds suggest important contrasts.

Technical entrepreneurs apparently have functioned effectively in the established educational structure. They were willing to go to school for many years, and apparently were successful at it, inasmuch as the typical founder had B.S. and M.S. Degrees.

With respect to career patterns, many of the founders clearly were successful in established organizations. In their previous positions before becoming entrepreneurs, the 30 founders studied included only five (17%) who did not have any subordinates; 50% had advanced to positions of major responsibility, including vice-president, general manager, sales manager, or director of engineering. (See Exhibit III-4)

In that phase of the research involving interviews with senior executives of established firms, they were asked their perceptions of the average level of competence of the entrepreneurs who had left their firms. How did these men compare with the average technical manager or engineer who stayed on with the established organization? Without exception, these senior executives replied that those who had become entrepreneurs were better than the average - more competent, more energetic, more concerned about the progress of the organization. They sometimes added that they considered some spin-offs to be a good sign, an indication that their company was employing the right kinds of people.

These founders did have a history of some job switching, but this may be typical of the West Coast electronics industry (Exhibit III-3). The typical founder was quite frustrated in his current position when he made the decision to strike out on his own. (Data relating to motivations are discussed at length in Chapter IV.) These may be the kinds of men who are not easy to keep contented in established organizations. However, as measured by their positions in the management hierarchy, the Palo Alto founders were men who left successful careers in established organizations to become entrepreneurs.

[5]Collins and Moore, op cit, p. 243.

[6]At this time, Dr. John Komives of the Center for Venture Management is engaged in a research project wherein technical entrepreneurs in the Palo Alto area have been asked to complete certain psychological tests. Findings from this project should provide additional evidence as to whether technical entrepreneurs have the strong resistance to authority found by Collins and Moore in their study on non-technical manufacturing entrepreneurs.

CONCLUSION

The decision to found an NTBF occurs rarely, for most engineers and technical managers never start their own companies. In many parts of the country, including some where substantial numbers of engineers are employed, the event has apparently never occurred. In trying to understand the elements which interact to culminate in this rare event - the birth of an NTBF, we shall use an analytical framework which focuses primarily upon three major influences: the entrepreneur himself, the incubator organization, and various external factors.

The typical technical entrepreneur is in his thirties, has a master's degree, and has achieved considerable professional success in his prior position. In the following chapters, we shall see how certain factors create an environment in which such a man may choose to take the step of starting his own firm.

CHAPTER IV

Incubator Organizations

The established organizations in a particular area affect regional entrepreneurship to an important degree. Any established firm is a potential incubator organization, employing and influencing potential entrepreneurs who may "spin off" to establish their own firms.

Regional entrepreneurship is closely related to the established firms or incubator organizations located in that same region. New firms are typically founded by entrepreneurs who are already employed in organizations in the same geographical area. In the Palo Alto area, it was found that 97.5% of the new companies (237 of 243) had one or more founders who were previously working in the area. In 92.2% of the new firms (224 of 243) all of the founders were already located there. One might presume that the Palo Alto area would be particularly attractive to the mobile entrepreneur, both because of its living conditions and the presumed advantages of being located in a "complex" of related firms. Despite these advantages, technical entrepreneurs have not come frequently from other parts of the country to start NTBF's in Palo Alto. Technical entrepreneurs tend to start firms where they are already living and working.

Interviews with founders suggest why they tend to start firms where they are already located. The tremendous number of tasks involved in getting a business started, including securing people and facilities and establishing relationships with suppliers and customers, is made much easier if the founder can rely upon contacts and knowledge already acquired in a particular area. In addition, it becomes possible to get some of these tasks started, to begin laying the groundwork, before abandoning the old job altogether.

The significance of these findings is that technical entrepreneurship in a particular area appears to be related closely to the incubator organizations already there. Unless such incubator organizations exist in a region, it is unlikely that there will be any new, technologically-based firms born there.

NATURE OF PRODUCTS OR SERVICES OFFERED

Established organizations in a given region also affect the kinds of new firms founded there. An entrepreneur typically starts his new firm to exploit that which he knows how to do best. This usually is related to the market and technical knowledge which he learned and helped to develop in the parent firm. In 85.5% of the cases studied in Palo Alto, the new firm served the same general market or utilized the same general technology as the parent company or companies. (See Exhibit IV-1.) For instance, the micro-wave laboratory of one large corporation had two spin-offs, both of which emphasized micro-wave technology. One competed directly with the parent firm; the other utilized similar technology, but emphasized segments of the market which the large firm had ignored. In another case, a semiconductor firm had an equipment division which designed and manufactured equipment for producing semi-

Exhibit IV-1

COMPARISON OF THE TECHNOLOGY AND MARKET OF THE NEW FIRM TO THOSE OF THE PARENT FIRM

(n = 220)

	Technology: Similar to Parent	Technology: Different from Parent
Market		
Similar to Parent	139 firms 63.2%	1 firm .5%
Different from Parent	48 firms 21.8%	32 firms 14.5%

conductors. There were four spin-offs from this division, all of which concentrated on semiconductor fabrication equipment.

Even though the founder may have worked in other fields in previous jobs, it is in the job which he has just left that he gains the most up-do-date knowledge of markets and technologies. This has implications in helping to explain spin-off rates from established organizations. Potential entrepreneurs within some firms are acquiring technical and market knowledge which cannot easily be applied in a new firm.

Industries vary widely in the extent to which there are attractive economic opportunities which can be exploited by new firms. If an industry is growing rapidly and if there is a high rate of technical change, there may be pockets of opportunity for the fledgling firm; a group of engineers with a product idea may be able to establish a competitive advantage in some segment of the market. Established firms in such an industry are teaching potential entrepreneurs skills which can be applied directly in a small or new firm, and the result may be a high spin-off rate. By contrast, an established firm in an industry which requires heavy capital investment or large organizations to compete is likely to have a low spin-off rate. For instance, many of the employees of an aerospace prime contractor or a large-scale producer of consumer electronic products are acquiring technical and market knowledge which would be difficult to apply on a small scale. On several occasions, the author has talked to engineers in large midwestern firms who hoped to become entrepreneurs. When asked what they could do better than their future competitors, they usually replied that they could produce on a mass basis at slightly lower cost. When asked about the investment required to put them into business, they usually concluded that at least one or two million dollars was required. Their firms usually did not have any spin-offs.

An important consideration in whether an established firm functions as an incubator is the nature of its business, and, in particular, whether the potential entrepreneurs within the organization are developing skills which can easily be exploited by a new firm.

ASSEMBLY OF THE ENTREPRENEURIAL TEAM

The incubator firm provides the organizational environment within which a team of founders can be assembled. It is often the staging area, where prospective co-founders become acquainted, judge each other's skills, and develop plans.

A new firm should have all of the major functional activities – including R & D, production, and marketing – performed reasonably well; there should be no areas of glaring weakness. Since there are few employees in the early days, this means that the founder or founders often must be able to design, produce, and sell the product themselves. Because of these needs, NTBF's are often started by groups of entrepreneurs, whose talents complement each other. In the Palo Alto area, about 61% of the new firms were started by teams of two or more founders. (See Exhibit IV-2.) In addition to the

Exhibit IV-2

NUMBER OF FIRMS WITH SINGLE FOUNDER AND WITH MULTIPLE FOUNDERS

	Number of Firms
Single Founder	88 - 39%
Multiple Founders	136 - 61%
Total Firms	224 100%

Exhibit IV-3

NUMBER OF FIRMS STARTED BY MULTIPLE FOUNDERS FROM ONE OR MULTIPLE PARENT ORGANIZATIONS

Organizations	Number of Firms
Single Parent Organization	78 - 57%
Multiple Parent Organizations	58 - 43%
Total Firms with More than One Founder	136 - 100%

Exhibit IV-4

NUMBER OF INDIVIDUAL FOUNDERS ON FOUNDING TEAMS FROM ONE PARENT, "FROM PRINCIPAL PARENT," OR MINOR PARENT ORGANIZATIONS*

	Number of Founders	
Single Parent Organization	230 - 54%	78%
"Principal Parent Organization"	99 - 24%	
Minor Parent Organization	91 - 22%	22%
Total Entrepreneurs on Founding Teams	420 - 100%	

*Does not include 88 individual founders who started companies by themselves. The principal parent firm is that parent firm accounting for the largest number of members of the founding team. If there are an equal number of founders from two organizations, one is arbitrarily designated as the principal parent.

broader base of talent which a group of founders provides, there are psychological advantages. A typical comment was, "As you take this step, it gives you encouragement to know that others are with you."

How does an entrepreneurial team get together? Typically the team is assembled by one man, who might be termed the "driving force," and who generally becomes the president of the new company. The founders may have gotten to know each other in various ways, including in engineering school, in prior jobs, or through being neighbors. However, in most instances, the incubator organization plays the role of bringing the founders together. For the entrepreneur is already in the incubator organization when he begins to develop specific plans relating to the proposed new firm, and it is in the incubator organization where he has the opportunity to judge closely the compatability and probable contributions of possible co-founders.

Of the firms started by teams of two or more entrepreneurs, 57% of the teams had all of the founders from the same parent firm. (See Exhibit IV-3.) Even when more than one parent firm was represented, it was common to have most of the team from the same organization. Of all of the individual entrepreneurs who were on founding teams of two or more founders, 78% were either from the same parent firm as their co-founders, or were from the "principal parent firm" for that management team.[1] (See Exhibit IV-4.)

One implication of these findings is that the birth of NTBF's is influenced by whether there are conditions under which founding teams can be assembled. Thus, new firms would be more likely to spin off from organizations in which the marketing, development, and manufacturing people have the opportunity of working closely together.

Testing the hypothesis that spin-off rates are related to the way a firm is organized would require data not now available. However, findings presented in Chapter V on spin-off rates from organizations of different size are consistent with these conclusions; in particular, small firms, characterized by close contact among functional areas, have higher spin-off rates.

A functional organization in which engineers talk primarily to engineers and manufacturing men talk primarily to manufacturing men seems relatively unpromising from the standpoint of organizing entrepreneurial teams.[2] Probably the least favorable structure for organizing such teams would involve an installation located in a small, relatively isolated town – away from similar businesses, and organized so that the people there are engaged primarily in only one activity – such as manufacturing. Incidentally, there are many engineers in midwestern towns employed in just such organizations.

[1]The principal parent firm is that parent firm accounting for the largest number of founders of the founding team. If there are an equal number of founders from two organizations, one is arbitrarily designated as the principal parent.

[2]One of the founders interviewed had organized his company on a functional basis, rather than a product-decentralized basis, because he thought that this would result in a lower subsequent spin-off rate from his own firm.

MOTIVATION FOR THE DECISION

The established firm also appears to influence to a marked degree the motivation of the individual entrepreneur as he makes this significant personal decision to quit his job and to undertake the risk and effort of getting a company started.

Of course, the motivations are complex and many personal considerations come to bear, including an individual's attitude toward risk-taking and the perceived social-status, risks, and rewards associated with entrepreneurship. In any given environment, some men will become entrepreneurs and some will not. Granting the complexity of these decisions, it was clear that the entrepreneurs studied in Palo Alto were motivated to an important degree by events which they perceived to be happening within the incubator organizations.

In most instances, spin-offs were indications of frustration within the established firm. Of thirty founders studied intensively, 70% could be described as highly frustrated in their previous positions. Of the remaining founders, 17% described themselves as happy in their previous positions and said they would have stayed in the parent organizations if they had not become entrepreneurs. An additional 13% were forced to leave through backruptcy, being "laid off," or the closing out of branch offices or plants with no attractive opportunities elsewhere in the company. (See Exhibit IV-5.)

It might be argued that *post hoc* rationalizations are unreliable, and that, in fact, these entrepreneurs may not have been so highly influenced by conditions within the incubator firms. However, many of these situations were relatively unambiguous with respect to this relationship, e.g. the 13% who were forced to leave by bankruptcy, etc.

Extreme frustration was particularly evident for those founders (30% of the total) who quit their previous jobs without any specific plans for the future. A typical situation involved an engineer in charge of one product line in a small firm. He had grown increasingly disturbed over his relationship with his superior, whom he believed to be lacking in competence; he also thought that he was being inadequately paid, considering the long hours he was working. When a proposal he had developed to expand his product line was rejected, he quit. Later that day, he asked himself, "What am I going to do now?"

Forty per-cent of the founders said that, even if they had not started their own businesses, they would have quit their previous positions. They usually went on to add a series of epithets about the extent of their frustration. One man commented, "I had become disillusioned; my immediate supervisor was a 'clod.' By the end of each day, I was so frustrated that it took three or four martinis for me to relax." One group of engineers, disturbed by what they saw as an absentee management unreceptive to new ideas, advertised themselves as a "department available" in the classified section of the newspaper. The major cause of frustration, broadly stated, was a lack of confidence in management, a feeling that poor decisions were being

Exhibit IV-5

MOTIVATION OF ENTREPRENEURS

(n = 30)

Forced to leave previous position		13%
Happy in previous position		17%
Frustrated in previous position:		
Quit without specific plans	30%	70%
"Would have quit even if had not become an entrepreneur"	40%	

made and that the division or company faced an unpromising future. As these men described their frustration, two areas of concern were mentioned again and again. One centered upon the selection and development of managers and was reflected in comments such as: "I could see the wrong people being placed in key positions;" or, "I couldn't respect my supervisor." The other area of major concern had to do with investment in products and technologies: "Management was investing in the wrong new products;" or, "The president wanted to take the company in a direction in which I had neither interest nor competence."

To what extent were these feelings the reflection of personal disappointment because pet projects were not supported or expected promotions not received? Making such a judgment is not easy, but the detailed comments of the entrepreneurs suggest that an element of personal disappointment was present in only about half of the situations studied. In these instances, there typically was a growing feeling of frustration and lack of confidence in the future of the firm; the turning down of a particular project or the loss of an expected promotion acted to trigger the entrepreneur's decision to leave the firm. The following comment is typical:

> *"All of us (who left) had grown increasingly irritated in the prior company. We were expected to work long hours, without any indication this was appreciated. The firm was poorly managed. The key engineers in the firm were on the verge of leaving. Finally, management decided not to produce a product line we had sweated to develop. Two of us quit on the spot."*

In about half of the situations, there was no evidence of personal disappointment, but rather a general disillusionment about the firm's prospects. A former manager of a technical group commented:

> *"After the acquisition, the parent company left us alone and hoped that profits would come. The local management was inadequate. Although they assured me that I had a bright future with the parent corporation, that would have meant going to corporate headquarters in the east, which I didn't want to do. It appeared the company would continue to disintegrate. It has since withered away."*

CONCLUSION

Clearly, regional entrepreneurship depends upon local incubator organizations which hire, train, bring together, and motivate prospective entrepreneurs.

How might one design an organization to have a high or low spin-off rate? A firm with the following characteristics probably would be a very good incubator. It would be in a rapidly growing industry which offered opportunities for the well-managed small firm with good ideas; it would be a small firm or would be organized as a series of "small businesses;" it would be good at recruiting ambitious, capable people; and it would periodically be afflicted with internal crises sufficient to frustrate many of its professional employees and lead them to believe that opportunities were being missed and that *"even I could manage the business better."* This, incidentally, is a fairly good definition of many of the firms which have been established in the Palo Alto area in the past ten years.

CHAPTER V

Spin-Off Rates From Established Organizations

In studying technical entrepreneurship, one can observe that some established organizations seem to be prolific incubators. If asked about the chief "product" of some of these firms, one might reply "entrepreneurs." Other established firms seem to have relatively few spin-offs.

There has been little previous investigation of the spin-off relationship. Analysis of spin-off rates from different kinds of organizations should indicate the extent to which, in an area of active entrepreneurship, organizations function differently as incubators. Such analysis should also indicate spin-off rates by type of established organization. This chapter focuses upon analysis of spin-off rates.

Any new, independent, technologically-based firm is defined as a "spin-off" regardless of whether or not it is engaged in the same kind of business as the established organization which the founders left. (Recall that about 85% of the new firms exploited the same general technology or served the same markets as the parent firms.) Although an entrepreneur may have worked for several previous employers, the organization which employed him immediately prior to his starting the new firm is defined as the incubator firm. If the new company is started by a group of entrepreneurs who represent different incubator organizations, (which was the case in about 26% of the new firms), the spin-off calculations are based upon the proportion of the founding group from each firm. Thus, if one founder is from Company A and one from Company B, the new firm is counted as 0.5 spin-offs from each parent company.[1] Only "full-time" founders were counted in determining spin-off rates.

Spin-off "rates" from an established organization are calculated as follows: the numerator consists of the total number of spin-offs from the organization during the period from January 1, 1960, to July 1, 1969; the denominator is the average number of total employees during this period.[2] Thus, a firm which employed an average of 500 employees during the 1960's and which had employed all of the founders of three new firms and half of the founders of another would have a spin-off rate for the decade of 3.5/500.

SPIN-OFF RATES

Based upon data developed in this study, one can calculate the average spin-off rate for the decade of the 1960's for the high-technology companies on the San Francisco Peninsula considered as a group. The average total employment for these companies was about 77,600.[3] There were 243 new firms identified for which incubator firms could be specified. Only six of these new companies (2.5% of the total) were started by founders who were from out of the area; 237 of these firms had one or more founders who had

[1]Some founders are more important than others and, ideally, one might wish to weight the spin-off calculations accordingly. However, information as to relative importance of founders is difficult to obtain and evaluate.

[2]Ideally, one might wish to base spin-off calculations on the number of professional employees only, since most technical entrepreneurs are from this group. However, these data were not available.

[3]Estimates of employment were arrived at by first using the survey data collected annually by the Western Electronic Manufacturers Association. These data were supplemented with employment figures for additional organizations known not to have been included in that survey.

been working for companies on the San Francisco Peninsula. The spin-off rate for the high-technology companies as a group was 237/77,600 or 1/306.

Spin-off rates were calculated for 325 firms, including many no longer in operation. The distribution of spin-off rates for these firms is given in Exhibit V-1. There were a number of companies, particularly small ones, which had had no spin-offs.

Among firms that had 3 or more spin-offs, the range in spin-off rates was from 1/3100 to 1/14. Sample spin-off rates, indicating the wide degree of variation, are given in Exhibit V-2. This wide variation is particularly notable when considering that all of these companies were in the same regional environment. Those geographical factors which might encourage entrepreneurship, including the availability of venture capital and the possible advantages of being located in a "complex" of related firms, presumably acted to encourage prospective entrepreneurs in all of the organizations in the area. Despite this, one finds vast variations in the extent to which established firms act as incubators of new firms.

THE EFFECT OF ORGANIZATIONAL SIZE

What kinds of organizations have high spin-off rates and what kinds have low rates? In essence, from what kinds of organizations do entrepreneurs come?

Spin-off rates were calculated for incubator firms in different size classes. Established firms were classified as under 500 employees, over 500 employees, and as subsidiaries of under 500 employees. As can be seen in Exhibit V-3, the spin-off rate for "small" firms was about ten times that for "large" firms. The spin-off rate for "small subsidiaries" was about eight times that for large firms.

These findings appear to be consistent with those reported by Forseth in his analysis of spin-off rates at four M.I.T. laboratories, although differences in definitions used make direct comparison difficult. In his analysis, the size of a laboratory was based upon total funding. He reported that spin-off rates were inversely related to laboratory size, that is, that the smallest laboratory had the highest spin-off rate, etc.[4]

It is common knowledge that certain large firms in the Palo Alto area have been important incubators. Companies such as Fairchild Semiconductor and Ampex have received considerable publicity in this respect. It is thus interesting that the highest spin-off *rates* belong to the classes of small firms and small subsidiaries.

The research suggests several reasons why small firms have higher spin-off rates:

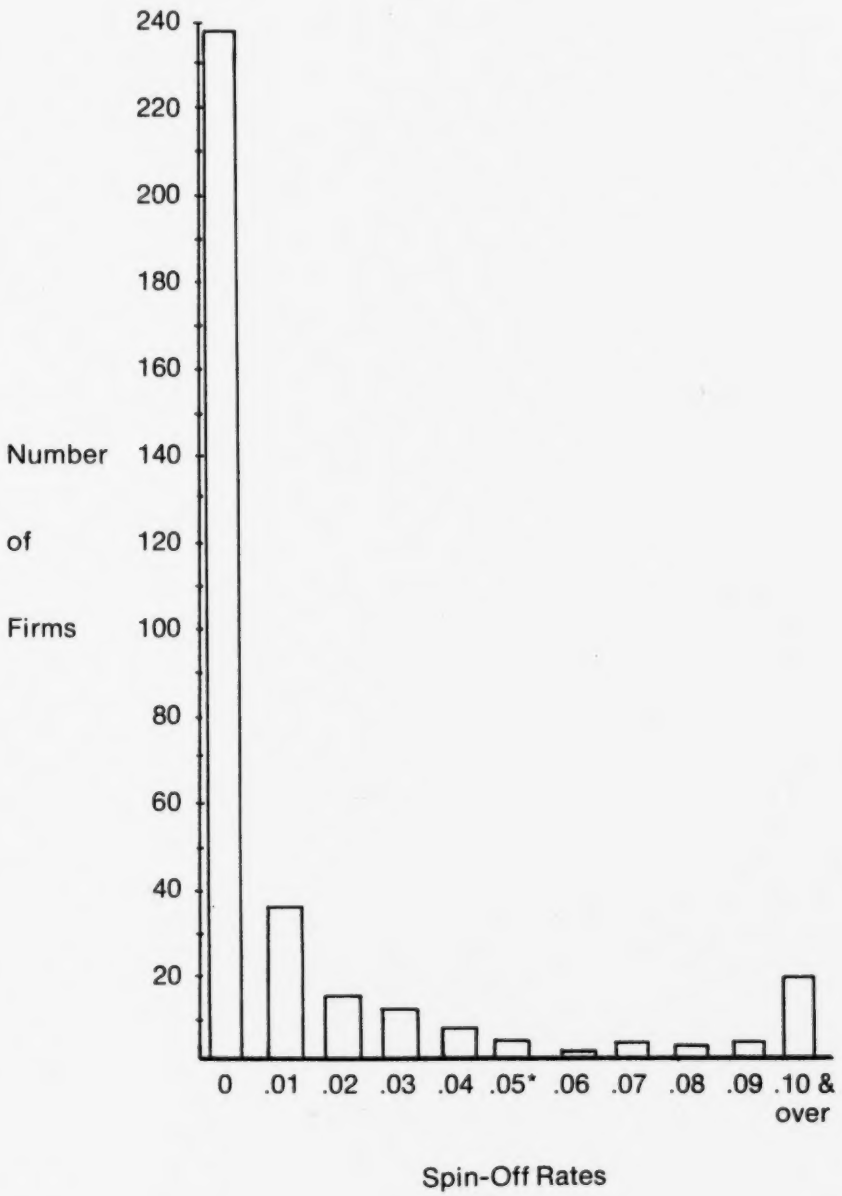
1. Large firms are often engaged in activities which require heavy capital investment or large organizations to compete; economies of scale are often important. A new firm, established to compete in these same seg-

[4]D. Forseth, The Role of Government Sponsored Research Laboratories in the Generation of New Enterprises, S. M. thesis, Sloan School of Management, Massachusetts Institute of Technology, 1966.

Exhibit V-1

FREQUENCY DISTRIBUTIONS OF
ESTIMATED SPIN-OFF RATES

(n = 325)



* .04 < Rate ≤ .05

The value at zero is a point reading, not an interval.

Exhibit V-2

SELECTED SPIN-OFF RATES FROM
ESTABLISHED ORGANIZATIONS
DURING DECADE OF THE 1960's

Company	No. of Spin-Offs/Mean Employment	Spin-Off Rate
A	8.3/25,700	1/3,100 = .0003
B	.33/750	1/2,250 = .0004
C	2.8/2400	1/850 = .0012
D	12.75/7,450	1/584 = .0017
E	1.7/600	1/283 = .0028
F	6.05/770	1/127 = .0079
G	3/180	1/60 = .0017
H	3/42	1/14 = .071

ments of industry, may be at a substantial disadvantage. By contrast, the employees of smaller firms are, by definition, learning how to do things which can be exploited by a small firm.

2. Professional employees in small firms develop rather broad backgrounds, often assume substantial responsibilities at early stages of their careers, and learn about the particular problems of managing a small firm. This experience constitutes a valuable education for the prospective entrepreneur. There is close contact among the managers in different functional areas so that it is easier to assemble a team of entrepreneurs with the requisite skills in development, manufacturing, and market.

3. There is probably a self-selection process, whereby those who choose to go to work for small and new firms are the most prone to be entrepreneurially inclined. These attitudes are likely to be reinforced in the small firm environment, as the technical employee learns what is involved in managing a small company and sees before him the living example of a successful entrepreneur - his employer.

4. Large firms probably employ a higher percentage of non-professional employees. These workers are less likely to become technical entrepreneurs than the engineers and managers. Thus, a higher percentage of the total employees in a small firm are potential entrepreneurs.

The extremely high spin-off rate for small subsidiaries is probably due, in part, to the above-mentioned factors. In addition, most of these subsidiaries had, at one time, been independent companies which were subsequently acquired. The management then had to adjust to being no longer independent. Terms of the acquisition often had made them relatively wealthy and liquid; the financing of new ventures was thus more feasible.

NON-PROFIT ORGANIZATIONS

To what extent do technical entrepreneurs come from non-profit organizations? Substantial publicity has been given to the fact that some new firms have been started by professors and students from engineering schools. In fact, it is often believed that the development of a complex of technically-oriented firms requires the proximity of a strong university.[5]

In the Palo Alto area, three major non-profit organizations employing technical personnel are Stanford University, Stanford Research Institute, and the Ames Research Center of the National Aeronautics and Space Administration. Lists of known spin-offs from each organization were developed; as a check on the completeness of these lists, senior personnel from each organization

[5]For instance, see E. Deutermann, "Seeding Science-Based Industry," New England Business Review, December, 1966, and "More Professors Put Campus Lab Theories to Work in Own Firms," Wall Street Journal, March 13, 1967.

Exhibit V-3

SPIN-OFF RATES FROM ESTABLISHED FIRMS
BY SIZE CLASS OF ESTABLISHED FIRM
DURING DECADE OF THE 1960's

Established Firms, Size Class*

	Less than 500 Personnel	More than 500 Personnel	Subsidiary Less than 500 Personnel	All Firms
Spin-Offs/Average Total Employment	96.5/5,800	120.0/70,300	20.5/1,500	237.0/77,600
Average Spin-Off Rate	1/59.2=.017	1/586=.0017	1/73.2=.014	1/306=.0031
Ratio of Rate to Rate of "Large Companies"	9.7:1	1:1	8.0:1	1.8:1

*Does not include spin-offs from universities.

If these spin-off rates were treated as random samples, the probability that all three samples come from the same population, i.e., that the three rates do not differ significantly, is less than .001.

Exhibit V-4

SPIN-OFF DATA
SELECTED NON-PROFIT ORGANIZATIONS

	Number of New Firms Spun-Off[a]	Number of Spin-Offs/ Mean Employment	Spin-Off Rate
Non-Profit Research Institute[b]	3	1.8/1220	1/678 = .0015
Government Research Center	1	1/1950	1/1950 = .0005
University - (engineering faculty and research associates)[c]	2	2/245	1/122 = .0082
(engineering faculty, research associates, and graduate students)[d]	2	2/1040	1/520 = .0019
(engineering, physical sciences, and business)[e]	4	3.75/2760	1/736 = .0014

[a] Number of new firms founded with at least one founder from the organization listed. Because some founders may have been from other organizations, these may count as fractional spin-offs in calculating spin-off rates.

[b] Various non-technologically oriented consulting firms have also spun-off; they are not included. Only those professional and support personnel associated with engineering and the physical sciences are included in the base population which constitutes the denominator.

[c] New firms founded by people from the engineering school divided by average number of engineering faculty and research associates.

[d] New firms founded by people from the engineering school divided by average number of engineering faculty, research associates, and graduate students.

[e] New technologically-based firms founded by people from any part of the university divided by average number of faculty, research associates, and graduate students in engineering, physical sciences, and business school.

were consulted to determine whether any omissions could be identified. For each of these organizations, spin-off rates were calculated. The findings are listed in Exhibit V-4. The definitions given previously were applied, so that only new, technologically-based firms founded since 1960 were included. Spin-off firms providing consulting of a non-technical nature were excluded.

The spin-off rate for the non-profit research institute (1/678) is about the same as that for large companies as a group. The rate for the government laboratory (1/1950) is very low, in fact one of the lowest rates encountered for any organization studied. The university spin-off rate varies from 1/122 to 1/736, depending upon the base population used. The appropriate population might be defined solely as engineering faculty and research associates; it might also be broadened to include faculty, research associates, and graduate students in engineering, the physical sciences, and business.

In total, these non-profit organizations have served as incubators for slightly less than 3% of the NTBF's founded in the 1960's. The principal incubators have been the industrial firms.

The fact that the Stanford University School of Engineering (one of the most prestigious in the country) has had relatively few spin-offs was surprising. There appears to be a marked contrast with the experience at the Massachusetts Institute of Technology; M.I.T. and its laboratories appear to have had much higher spin-off rates.[6] It is difficult to make direct comparisons of data, because of differences in definitions used; for instance, in this study of Palo Alto spin-offs, part-time businesses, as well as management consulting and computer software firms, were not included. Situations in which professors served as part-time consultants were not counted as university spin-offs. Further research, focusing upon differences in the Stanford and M.I.T. experience would be illuminating. One factor which may account for some differences is that Stanford, unlike M.I.T., does not employ large numbers of full-time researchers in semi-independent laboratories.

In response to queries about the low spin-off rate from the government laboratory, two reasons were suggested most often by those who knew the laboratory. One was that much of the work being done there did not appear to have great commercial applicability. In addition, the typical professional employee was described as more scientifically oriented and less commercially and entrepreneurially oriented than his industrial counterpart.

VARIATIONS WITHIN LARGE ORGANIZATIONS

For some of the large, prolific incubator firms in the area, spin-off data were available for individual parts of the organization. The data are illustrated by the following examples.

a. One rapidly growing firm had eight spin-offs during the decade of the 1960's. Eighty percent of the firm's employees were in one division whose activities were concerned mainly with one large government contract

[6]Roberts and Wainer, op cit, pp. 78-79

and the associated follow-on contracts. Only one of the firm's spin-offs was from this division, while the remaining spin-offs were from the other 20% of the company's business.

b. One semiconductor manufacturer had about 85% of its personnel working on the development and production of semiconductor devices, with the remainder in the equipment division which developed production equipment for manufacturing semiconductors. Of the firm's six spin-offs, four were from the small equipment division.

c. One large firm had had no spin-offs from the major division which accounted for 50% of its sales. All seven of its Palo Alto spin-offs came from smaller departments which offered a variety of products and which made up the other 50% of the business.

Such evidence suggests that in large firms the spin-off rate is likely to be highest in those departments which constitute the "small businesses" of the firm. This hypothesis is entirely consistent with the finding that small firms as a class have higher spin-off rates. The reasons advanced for explaining the high spin-off rate for small firms probably also apply here. In addition, small divisions of larger firms may, on the average, be more poorly managed than the large divisions and may have more frustrated managers. This may be because of their low visibility, the fact that top management often comes from "backbone divisions," and because the small divisions lack internal bargaining power to obtain discretionary resources such as investments in new products.

CONCLUSION

The founding of new, technologically-based firms seems to be closely related to the characteristics of established "incubator organizations." In this initial attempt to examine the phenomenon of spin-off rates, data were gathered on new companies founded in the Palo Alto area during the decade of the 1960's. Salient findings were as follows:

1. Spin-off rates from established organizations varied widely, the range of variation being of the order of 200 to 1.

2. Firms with more than 500 employees had, as a class, the lowest spin-off rates. Small firms as a class had spin-off rates ten times as high as the large firms, and small subsidiaries had a rate eight times as high as the large firms.

3. Of the major non-profit incubator organizations, the university and the non-profit research institute had spin-off rates comparable to large scale industry; the major government laboratory had a very low spin-off

rate. The non-profit organizations have served as incubators for less than 3% of the new, technologically-based firms in the 1960's.

4. Limited evidence suggests that in large firms the largest divisions have the lowest spin-off rates.

Clearly, spin-off rates vary widely among established firms, and some kinds of organizations appear to function as incubators to a greater extent than others. This research suggests the importance of the organizational setting as a variable influencing the entrepreneurial decision.

CHAPTER VI

Regional Differences in Technical Entrepreneurship

Why does technical entrepreneurship seem to take root in some areas and not in others? In 1967, the "Panel on Invention and Innovation" took note of these regional differences:

> *"Cities and regions appear to vary markediy with respect to successful generation of new technologically based enterprises. Unfortunately, there are no statistical data to show this. But our personal experiences – and we claim no more proof than that – tell us that cities and regions do vary widely in their propensity to exploit their innovative potential. We surmise that important factors exist which go beyond such indexes as the total number of scientists in the area, or the total R & D expenditures, or the availability of capital."*[1]

Previous observers have pinpointed several factors which may be important in creating a favorable climate for entrepreneurship. One researcher concluded that the significant differences between the Boston and Philadelphia experiences were due primarily to two factors: the attitudes of the banks and the presence of strong graduate engineering schools.[2] The observation that the leading complexes to date have grown around strong universities has led to the conclusion that this is a critical factor, with university policies which permit and encourage consulting and close relationships with industry being additional requirements.[3] Since highly-trained technical people are mobile and often can choose where they want to live, sunshine and cultural attractions are believed to be highly desirable.[4] Local sources of venture capital, sympathetic to technical ventures, is another factor sometimes mentioned.[5]

Despite the above references, previous research into causes of regional differences in entrepreneurship has not been extensive. It is obvious that the processes influencing entrepreneurship are complex and that a number of factors act and interact. Clearly, no single factor is sufficient to create a climate favorable for entrepreneurship. One can point to regions which have strong engineering colleges, or delightful climates, or the presence of thousands of engineers, but which do not have significant technical entrepreneurship. One can also note that some regions change over time, Palo Alto had relatively little technical entrepreneurship before World War II, and most of the NTBF's founded in Minneapolis-St. Paul were started since 1950. Apparently, the regional climate for entrepreneurship can change over time, with various casual factors at work.

One approach to understanding the environmental influences upon entrepreneurship is to study how individual firms get started in an area of active entrepreneurship and to determine those regional factors which seem to exert influence. Ideally, one might wish to study such a region over time, as the rate of entrepreneurship

[1] Technival Innovation: Its Environment and Management, p. 13.

[2] Deutermann, op cit.

[3] D. Allison, "The University and Regional Prosperity," International Science And Technology, April 1965.

[4] J. F. Mahar and D. C. Coddington, "The Scientific Complex - Proceed With Caution," Harvard Business Review, Jan. - Feb. 1965.

[5] A. Shapero, R. Howell, and K. Draheim, The Structure and Dynamics of the Defense R & D Industry, Menlo Park, Calif.: Stanford Research Institute, 1965.

changes. One might also gain insights from explicitly studying and comparing different regions with contrasting rates of entrepreneurship.

This study, with its focus upon new firms founded in the Palo Alto region during the 1960's, does not have some of the dimensions of the "ideal study" described above. However, it does permit us to identify a number of regional factors which seem to be important, and to develop a theory of how these factors interrelate in creating a climate favorable to technical entrepreneurship.

MAJOR INFLUENCES

In "A Framework for Understanding Entrepreneurship," presented in Chapter III, three major influences upon entrepreneurship were discussed. They were the individual, the incubator organization, and "various external factors, many of them regional in nature." Although all of these may influence regional entrepreneurship, the evidence in this study relates particularly to the role of the incubator organization and those external factors which differ from region to region.

The decision to found a new firm is an intensely personal decision, and those past experiences which affect an individual's inclination to take this step are clearly important. One can speculate as to whether engineers in different parts of the country have differing inclinations toward entrepreneurship. Unquestionably, on a national scale, there is a migration of engineers to the West.[6] Possibly, those who migrate are more inclined to be risk-takers, resulting in an accumulation of engineers on the West Coast who are more likely to undertake high-risk activities such as becoming entrepreneurs. We do not have evidence relating to these interesting speculations at this time. Future research may show whether there are regional differences in these personal traits.

The nature of established incubator organizations clearly does vary substantially from region to region. As discussed in Chapter IV, the Palo Alto experience suggests that established firms influence entrepreneurship in several ways, including the location of the new firms, the nature of products or services offered, the assembly of founding teams, and the motivations of the founders. We further note that, even within an area of active entrepreneurship, established organizations vary widely in the extent to which they function as incubators.

The implications of these findings for understanding regional differences in technical entrepreneurship are the following:

1. Within a given region, unless there are established organizations employing potential technical entrepreneurs, there are unlikely to be any NTBF's founded.
2. Whether spin-offs occur depends, in part, upon the nature of the established organizations. Their size, the way they are organized, their success in recruiting capable, ambitious people, and the extent to which they

[6]Ibid, pp. 27-39.

provide satisfactions or frustrations for their professional employees are determinants of whether founders will spin off. It is also important whether potential entrepreneurs are acquiring technical and market knowledge which relates to areas of expanding opportunity which can be exploited on a small scale by a new firm.

Regional differences in technical entrepreneurship reflect, in part, regional differences in the presence and nature of established, potential incubator organizations.

Another influence which appears to vary from region to region consists of a network of external factors, many of which appear to depend upon past entrepreneurship. Some of these appear to be much more important than others. They include: 1. an "entrepreneurial environment;" 2. the existence of new, small incubator firms and a "pool" of experienced entrepreneurs; 3. the presence of specialized sources of venture capital; 4. the role of universities; 5. the presence of a "complex" of related firms; and 6. the presence of attractive living conditions.

ENTREPRENEURIAL ENVIRONMENT

The decision to start a new firm obviously involves considerable risk. The prospective founder must weigh the risks and rewards of entrepreneurship as he perceives them, and then decide whether this step, with all of its sacrifices and uncertainties, should be undertaken by him and his family.

The environment in which a prospective entrepreneur finds himself can significantly affect his perceptions of the risks and rewards involved in entrepreneurship. The San Francisco Peninsula area has developed what might be termed an "entrepreneurial environment," and this has probably been an important factor in the high birth rate of NTBF's in that area.

An entrepreneurial environment might be defined as a situation in which prospective founders of new firms have a high awareness of past entrepreneurial action, of sources of venture capital, and of individuals and institutions which might provide help and advice. In such an environment, surrounded by examples of success and information about entrepreneurship, the prospective founder may perceive the risks associated with entrepreneurship to be relatively low and the rewards to be relatively high.

Most of the founders of the 30 companies studied intensively knew of many examples of the action which they were considering. Many had observed prior spin-offs from the firms they were leaving. At the time they made the decision, 93% of the founders knew of other founders of NTBF's; many were known personally. (Interestingly, they tended to know of successful NTBF's, but rarely of unsuccessful ones.) In thinking about the decision which they had made, most thought that their decision had been made easier because they were located in an area in which technical entrepreneurship abounded. A typical comment was, "Men whom I had gone to

school with had already taken this step and were doing well. If they could do it, I thought I could too."

As they made the decision to start a firm, most of the entrepreneurs later described themselves as very confident. Seventy-seven percent said they admitted almost no chance of failure, and were sure they could make the new business succeed; only 13% admitted to serious concern or saw themselves as undertaking a very risky venture.

Contrast the experience of these thirty founders with that of some engineers in the Middle West recently interviewed by the author. These men were trying to become the first spin-off from a very large technically-oriented business located in a small Midwestern town. This business operates in an industry which has had many spin-offs in the Palo Alto area. These men did not know of any prior spin-offs from their company; in fact, they did not know personally any technical entrepreneurs. They did not know of any regional sources of venture capital. If they surrendered the security of their monthly paychecks and risked their life savings, they could not reassure themselves or their wives that this was a step which other men, like themselves, had taken and succeeded at. Eventually, they gave up their plans and went to work individually for other employers.

Study of the Palo Alto area during the 1960's does not answer the question of how an entrepreneurial environment gets started. Presumably, the first instances of entrepreneurship in a region take place without this influence. Each successful new firm then provides an example for others who may follow. In time, an environment may develop such that the prospective founder is exposed to many successful examples of entrepreneurship and finds it relatively easy to learn about what is involved in starting and financing a company.

THE EXISTENCE OF NEW, SMALL INCUBATOR FIRMS AND EXPERIENCED ENTREPRENEURS

An executive who is considering the major step of founding a new firm must ask himself, "What is involved in getting a company started and do I know how to do these things?" He must also consider whether managing an established small firm will present problems similar to those he has dealt with in the past.

The fact that substantial entrepreneurship has already occurred in the Palo Alto area means that many new and small firms are now located there; in many ways these small firms are almost ideal incubators. The employees in these firms are, by definition, acquiring market and technical knowledge which can be exploited by a small firm. They are also learning what is involved in managing a new, technologically-based firm. Recall that study of spin-off rates in the Palo Alto area indicated that the class of firms with less than 500 employees had a spin-off rate 10 times as high as firms with more than 500 employees.(See Chapter V.) Thus, past entrepre-

neurship generates new and small firms which seem uniquely suited to function as incubators.

Past entrepreneurship also generates experienced entrepreneurs. Some of these men stay with their firms as they grow. However, many of the firms are acquired and many of the founding teams break up. After the merger or after the fight with the co-founder, what does the former entrepreneur do? Often he turns to entrepreneurship agian. Eight of the 30 companies studied intensively in the Palo Alto area were founded by men who had been in the founding groups of other companies previously. One man was starting his fourth new business. Without exception, these men indicated that it was easier to start a company the second time, both in regard to making the decision psychologically and in regard to knowing what was involved in launching a firm.

In the Palo Alto area in the year 1968 alone, there were 44 NTBF's founded, involving some 118 individual entrepreneurs. There are probably almost 1000 experienced technical entrepreneurs in the Palo Alto area. The presence of these men makes future entrepreneurship more likely.

SOURCES OF VENTURE CAPITAL

The birth of new firms depends upon the availability of venture capital. In the Palo Alto area, a number of sources of venture capital specialize in investing in and assisting NTBF's. The presence of some of these sources is clearly related to the high level of entrepreneurship which has existed there in the past. During the 1960's, a major source of venture capital was the successful entrepreneur of the 1950's.

A typical situation involves the entrepreneur who has founded a successful firm and then later sold out; he may be wealthy and still relatively young. Often, there are many investors who previously have made money through backing his judgment; he may feel that the one thing which he knows best is how to help an NTBF get started. What does the successful entrepreneur do? In the Palo Alto area, he sometimes has become a venture capitalist, investing in and advising the next generation of entrepreneurs. His influence often extends beyond his own fortune, for there are investors willing to back his judgment again.

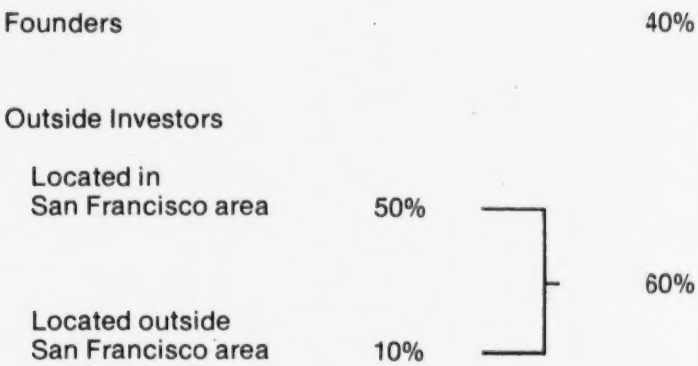
There are also a substantial number of experienced entrepreneurs, still managing their firms, who play a key role in advising investors and prospective entrepreneurs. One company president estimated that, on the average, he judged one new company proposal per week. If the venture looked promising he helped the prospective founder get together with what he termed his "stable of investors." This is typical of the well-developed communication networks which permit the prospective founder to make contact with sources of capital.

The success of many of the firms in the Palo Alto area has created substantial stock values, not only for the founders but also for key employees. An important source of initial capital in 43% of the

Exhibit VI-1

PRIMARY SOURCE OF CAPITAL

(n = 30)



firms studied intensively was stock held by the founders in the firms for which they had previously worked. Some of these men had been founders previously: others had been able to exercise stock options. Since stock ownership is often seen as a way of tying an executive to a firm, it is interesting to note that this ownership has often made if financially possible for key men to leave and start their own firms!

In the Palo Alto area, there are also a number of venture capital firms which specialize in investing in and advising NTBF's. A continuing flow of entrepreneurs seeking capital has provided the opportunity for such firms to develop there. Although there has been some venture capital imported from other parts of the country, most new firms have been financed locally. Of 30 firms studied intensively, 18 raised outside capital, and 15 of these raised all or a substantial part of their capital in the San Francisco Bay region. (See Exhibit VI-1.) Many of these founders believed it would have been much more difficult to sell stock in other parts of the country. (Some had, in fact, tried to do just that, with little success.) Several reasons for this belief were advanced: 1. they lacked ways of learning about and making contact with the "right" potential investors in other areas; 2. investors in the San Francisco Bay area were more likely to understand and be sympathetic to technologically-oriented businesses; 3. potential local investors could easily check into the background of the aspiring entrepreneur — they often knew him already — and they could keep in close touch with the new firms; presentations and proposals to such local investors did not have to be so elaborate.

In Palo Alto, past entrepreneurship and the wealth created by these successful firms have made possible the growth of a local venture capital industry. Future entrepreneurs are by no means assured of venture capital; however, it is relatively easy for them to make contact with institutions experienced in helping NTBF's.

Certain other regional factors, sometimes presumed to be important, appear to have played a secondary role in the Palo Alto area in the 1960's. These are discussed below.

THE ROLE OF UNIVERSITIES

There is a general feeling that a first-rate university is important in the overall process of creating a complex of technically-oriented firms.[7]

However, this study indicates that the universities have not played an important role as incubators of NTBF's. Only 6 of 243 firms studied had one or more full-time founders who came directly from any of the universities in the area or their laboratories. (See Chapter V.) In the 30 firms studied intensively, the founders did not appear to give any weight to the presence of the universities in making the decisions to start their companies.

In the early days of the development of the Palo Alto complex, many of the new firms apparently did have close relationships with

[7]For instance, see: Deutermann, op cit; "More Professors Put Campus Lab Theories to Work in Own Firms", Wall Street Journal, March 13, 1967; Allison, op cit; Roberts and Wainer, op cit.

Stanford, in some instances spinning off directly from the university. Some of these firms, such as Hewlett-Packard, subsequently had substantial economic impact. It might be argued that the universities played an important role in seeding and nurturing the early development of this complex.

During the 1960's, the local universities appear to have contributed to technical entrepreneurship in a less direct manner than through being major incubators. They have educated many of the entrepreneurs; in some instances, entrepreneurs first came to the Bay area to pursue a degree and then chose to stay on. (Of the 30 entrepreneurs studied intensively, 29 had university degrees; 17 of these received their last degree in the San Francisco Bay area, and 9 of these received their last degree from Stanford.) In the continuing struggle to keep abreast of current scientific knowledge, the local universities provide consulting assistance, as well as opportunities for continuing education for professional employees. They have apparently helped to attract the branch plants and laboratories which have, in turn, spun off new firms. According to the entrepreneurs interviewed, the universities have also added to the overall attractiveness of the area and have given the new firms advantages in recruiting technical personnel. However, during the 1960's in the Palo Alto area, it has been the industrial firms, not the universities, which have served as the principal incubator organizations.

A COMPLEX OF RELATED FIRMS

The many technologically-based companies in the Palo Alto area, and particularly the electronics firms, create a complex of interrelated businesses, some of which buy from and sell to each other. One might presume that an NTBF, starting in such a complex, would enjoy a competitive advantage, because of close proximity to customers and suppliers, and because of access to trained personnel. Thus, one might predict that NTBF's would be established primarily in existing complexes.

The experience of the 30 firms studied intensively indicates that location in a complex is very important for some new firms, but is not a significant competitve advantage for most of them.

Five of the 30 firms were primarily suppliers to other Palo Alto area electronic firms. These companies, emphasizing custom fabrication, relied heavily upon face-to-face contact with the technical personnel of the customer companies. For these satellite firms, initial location outside an existing complex would have been difficult if not inconceivable.

However, the rest of the founders either saw no significant marketing advantages to being located in the Palo Alto area, or noted that their primary markets were in other parts of the country. Often, these latter executives would say that, from a marketing standpoint, they would be better off to be located in the Middle West or on the East Coast.

In regard to specialized suppliers, 9 of the 30 founders saw marked or slight advantages associated with being located in the Palo Alto

complex. However, the other founders thought they could have been serviced as well in almost any major city, and 4 of the founders thought that certain other locations offered advantages in regard to supplier relationships.

The ability to attract and keep good technical personnel is important for rapidly growing firms which exploit new technology to achieve a competitive advantage. Most of the founders believed that location in Palo Alto gave them an advantage in this respect. One founder commented, "In our technology the best-trained technicians in the world are located in this valley, and we're in a position to hire them."

One particular advantage of the established complex is its ability to support consultants. Almost one-third of the founders left their former jobs without specific plans for the future. In many instances, consulting provided a way for the founder to support himself while plans were crystallizing and capital was being raised.

In certain other respects, this location was considered to be relatively unattractive by the entrepreneurs. Wages for non-professional personnel, taxes, and manufacturing space are all considered to be relatively expensive in the Palo Alto area. As one founder commented, "This is not a low cost area in which to do business."

Location in an established complex offers competitive advantages for some NTBF's. However, it would be a mistake to assume that all or most of these NTBF's require location in the Palo Alto complex to be successful. On the whole, most of these firms did not appear to be located in this complex because of careful economic analyses of the implications of location. Rather, they were located there because founders tend to start new companies where they are already working, and these founders were already there.

ATTRACTIVE LIVING CONDITIONS

Potential technical entrepreneurs are usually highly trained people who could choose from many job opportunities. They are also the kind of people who are concerned about living conditions, including the quality of schools, recreational opportunities, and cultural attractions. Most observers would consider the Palo Alto area superior in regard to all of these factors. To what extent have desirable living conditions directly influenced the high rate of technical entrepreneurship on the San Francisco Peninsula?

One cannot argue with the proposition that attractive living conditions can play an important role in attracting technically-trained people to an area. For this reason, established firms often choose to locate branch plants and laboratories in such regions, where they expect to enjoy a competitive advantage in recruiting. In fact, of the 30 founders studied intensively, 14 came from elsewhere to take jobs in the Palo Alto area; in addition, other founders came to the San Francisco Bay area to get university degrees and then stayed on.

However, recall that most of the entrepreneurs were already living and working in the Palo Alto area when they founded their firms; despite attractive living conditions, very few founders were attracted from elsewhere at the time they started their companies.

For those founders who were already there, the decision to start a new firm did not seem to be influenced directly by living conditions. Exceptions were two instances in which the established organizations were to be moved to other parts of the country and the engineers or their wives did not want to go. Most of the entrepreneurs did express a liking for the region, and this may have been one factor causing them to be willing to make a permanent commitment. However, as entrepreneurs described those factors which they perceived to have influenced their decisions, opportunities and frustrations were often mentioned, but living conditions were not. The "sunshine and surf" may be a primary factor in attracting potential technical entrepreneurs to a region; however, it does not appear to play a prominent role in subsequent decisions to found new firms.

CONCLUSION

Based upon the previously discussed findings, how can we explain regional differences in technical entrepreneurship? Ideally, one would like to be able to study a region through time as the rate of entrepreneurship changes. However, based upon this intensive study of the Palo Alto area, it is possible to construct a theory about how entrepreneurially active areas get that way.

If an area is to develop technical entrepreneurship, organizations which can serve as incubators must be present or be attracted or created. Since founders tend to start firms where they are already living and working, there must be organizations which will hire, bring into the area, and train the engineers, scientists, and technical managers who may someday become technical entrepreneurs.

However, the nature of these organizations is critical in determining whether spin-offs actually occur. It is certainly not difficult to point to cities where thousands of engineers are employed, but where there is little entrepreneurship. If the established firms serve markets which are stable or declining, there is little incentive for the prospective entrepreneur to enter the field. If the established firms are in industries which require large capital investments or substantial organizations to compete, it will be difficult to assemble the critical mass needed to get a new firm started. If the potential incubator firms hire relatively undynamic people, train them narrowly, and organize so that engineers talk only to engineers, etc., then it will be difficult to assemble a founding team with the needed knowledge and skills in marketing, engineering, and manufacturing. If the established firms are well-managed and avoid periodic crises, there may be little incentive for potential founders to leave comfortable positions.

In an environment in which the established firms are as described

above, there probably has been little past entrepreneurship. Under such conditions, a would-be founder will find the going difficult. If he seeks to bolster his confidence or to gain advice, he will find few successful founders who have preceded him. If he seeks to support himself as a consultant while formulating his plans and raising capital, he may find this difficult if he is in a "one company" town. Sources of venture capital experienced in investing in NTBF's may not be available locally, and making contact with possible investors may be laborious and time-consuming. In such an environment, the prospective founder's personal experience is likely to have been in large, established firms; he is likely to know little about what is involved in starting and managing an NTBF.

If there are new firms started in such an environment, the founders are likely to come from promising new ventures or particular "small businesses" within the established firms. Possibly, they involve those rare instances in which the founder comes from another geographical location or starts a new company not related to the business of the parent firm which he has left.

If the first new companies are successful, then their success begins to change the environment. These new firms are likely to be better incubators, that is to have higher spin-off rates, than the older firms which their founders left. Their success many begin to convince others that entrepreneurship is feasible and rewarding. Potential investors may be encouraged or created by the success of the new firms; financial consultants and venture capital firms may then develop. Future founders then find a more promising environment than those who went before.

The rate of entrepreneurial activity may be accelerated or diminished by a number of factors. One of the most important is the development of the markets and technologies on which the area's industry is based. If the rates of market growth and technological change decline, then technical entrepreneurship will lessen, for potential founders will find fewer areas of opportunity. Public attitudes relating to the "new issue market" are also Important, for they affect substantially the availability of venture capital.

However, if these factors are favorable, a self-reinforcing process takes place, in that past entrepreneurship makes future entrepreneurship more likely, and, in time, a high rate of entrepreneurial activity may develop.

CHAPTER VII

The Birth And Death Of Firms Over Time

How has the birth of NTBF's in the Palo Alto area changed over time? During the nine full years for which data are available, the number of new firms started annually varied from 16 in 1965 to 44 in 1968. (See Exhibit VII-1.) (During the first half of 1969, 18 foundings were identified; this number is undoubtedly understated because new firms often do not become "visible" until several months after founding, and the cut-off date for the study was July 1, 1969.)

Spin-off rates were calculated for each year, based upon estimated total regional employment in technological enterprises for each year. The spin-off rate per year varied from 1/4656 or .00021 in 1965 to 1/2170 or .00046 in 1968.[1] (See Exhibit VII-2.)

The discussion of regional factors affecting technical entrepreneurship in Chapter VI suggested that feedback mechanisms operate such that past entrepreneurship makes future entrepreneurship more likely. This leads to the conclusion that, other things being equal, the birth-rate of new firms should increase over time.

The average number of firms founded in the later years of the decade was somewhat higher than in the earlier years. (During 1960-1963, the mean number of firms founded annually was 20.2, and during 1965-1968, the mean number was 31.2.)

However, examination of birth *rates* in the scatter diagrams in Exhibit VII-2 shows a decline from a peak in 1961 to a lower level in the middle 1960's and then an increase toward the end of the decade. Evidence from this limited period does not indicate a marked increase over time in the annual birth-rate of NTBF's. Possibly, examination of a longer period of time, including the early days of the development of the Palo Alto complex, would disclose whether the birth-rate of new firms has increased over time.

VOLATILITY OF THE FIRMS

What happens to the new firms after they are founded? In studying these new companies, one is immediately impressed by their volatility. The firms seem always to be changing — their management, their ownership, even their names. After a firm is founded, the passing of each additional year increases the probability that it will have been acquired or that one or more of the founders will have left. (See Exhibit VII-3.) After five years, only slightly more than half of the NTBF's were still operated as independent firms with the original founding team intact. The actual frequency of change is undoubtedly greater, inasmuch as it is often difficult to learn about these changes.

Known instances of outright failure appear to be quite rare.[2] This contrasts sharply with an earlier study which showed the discontinuance rate for manufacturing firms as a whole to be much

[1]These spin-off rates are annual rates. Those calculated in Chapter V are rates for the decade, in which the numerator in the calculations is the number of firms founded during the 9½ year period studied.

[2]The failure rate may have been higher had the period of study been extended beyond mid-1969, so as to include the recession months which followed.

Exhibit VII-1

NEW ENTERPRISE FORMATION BY YEAR
IN PALO ALTO AREA

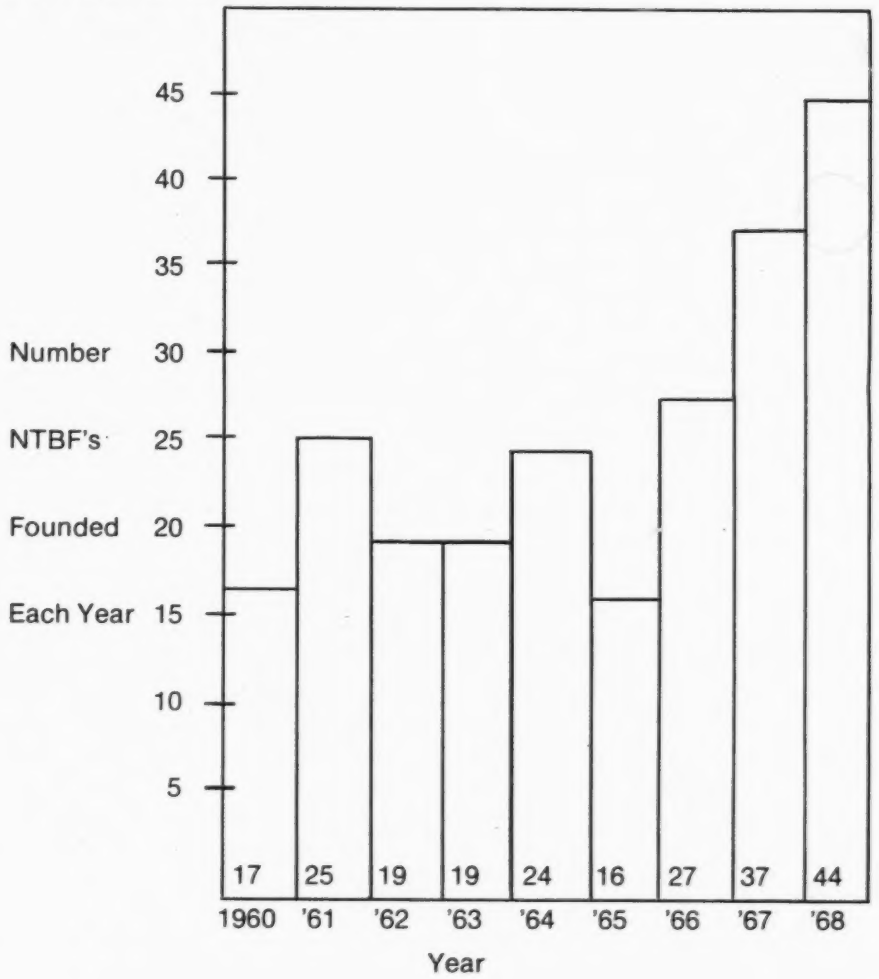
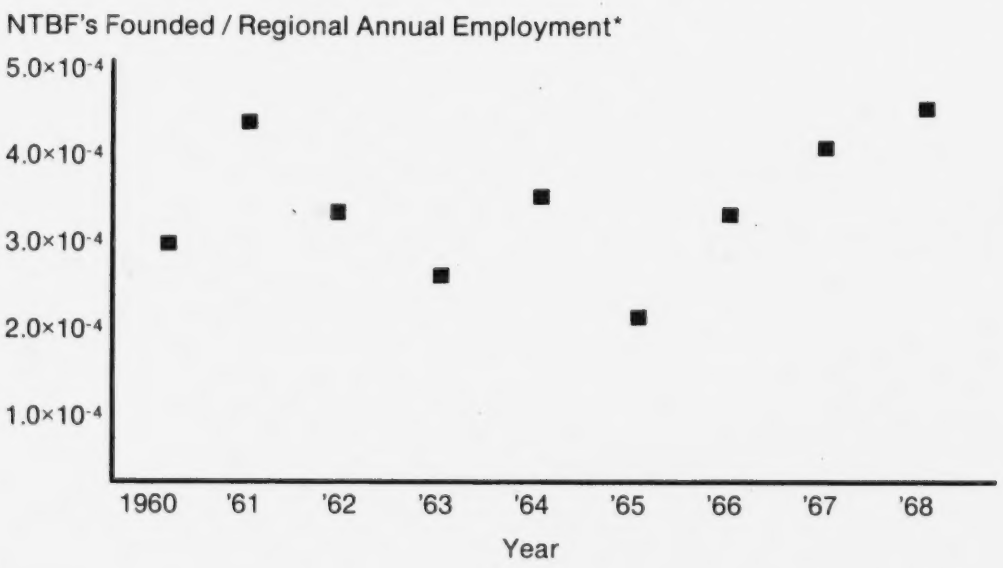


Exhibit VII-2

ANNUAL RATIO PALO ALTO NTBF BIRTHS
RELATIVE TO EMPLOYMENT BASE



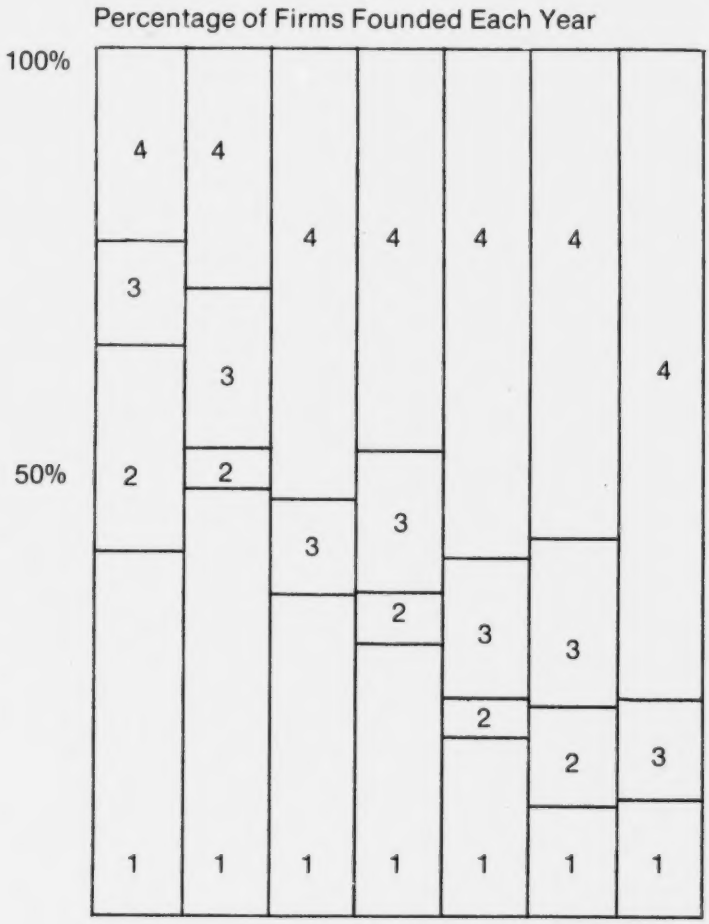
Annual

*Annual employment in technologically-oriented organizations in Palo Alto Area. Employment estimates are based upon the annual surveys of the Western Electronic Manufacturers Association, adjusted for organizations known not to be included.

Exhibit VII-3

VOLATILITY OF FIRMS

Percentage of Firms Founded Each Year Which Subsequently Failed, Were Acquired, Or Had At Least One Founder Depart by July 1, 1969



Year	1960	1961	1962	1963	1964	1965	1966
Number of Firms Founded Each Year	17	25	19	19	24	16	27
Acquired				1			
Failed				2			
Independent firms, one or more founders departed				3			
Independent firms, all founders remain				4			

higher than that found here. Of newly established or acquired manufacturing firms, about 40% did not survive the first 1½ years and 67% the first 4½ years. Non-survival included sale or liquidation. About 40% of the non-surviving firms were liquidated and the remainder were sold.[3]

In a study of NTBF's in the Boston area, Roberts and Wainer found "a total failure rate of only 20% over the full average four to five years period of existence of our new enterprises."[4]

It may be that the failure rate in the Palo Alto area is understated. The firms most likely to have been overlooked in the study are those which failed before they ever acquired much visibility.

However, there is another reason why the failure rate seems low. The end result for both successful and unsuccessful NTBF's is often the same — acquisition. Even a group of founders who have been unable to develop a viable business are usually worth something to an acquiring firm because of their know-how. Thus it is that one will learn that the "X Electronics Company," which had two employees, has been acquired, with the president of "X" slated to become a department head in the acquiring firm. The general feeling in the industry may be that "X" failed, yet the former founder will be quick to point out that they did not fail, but were only acquired.

The departure of founders occurs with surprising frequency, even from successful businesses. About 61% of these companies were started by two or more full-time founders. Focusing only upon these multiple-founder firms which are still in existence as independent firms after 4 or more years, one finds that only 52% still have their full founding teams intact. (See Exhibit VII-4.) As the new firm struggles for survival, the relationships in the founding group often come under intense pressure. Struggles for power are not uncommon. Some founders prove to be incompatible, lacking in the necessary skills, or unwilling to continue the fight.

Interestingly enough, even name changes are common among these new firms, particularly during the early months when things are most fluid. Of 243 firms founded during the 1960's, at least 36 had changed their names by mid-1969. Several had had more than two names. Often the change was slight, such as from Smith Development to Smith Optronics; in other instances, the successive names seemed to be completely unrelated. When the new firm had had limited success, the new name seemed to be a way to tell the world that things had changed, that with new capital, new key people, and a new name, there was to be a fresh start. It might be added that these name changes complicate the task of studying all of the NTBF's that have been founded in an area.

The high degree of change associated with these firms perhaps reached the ultimate in regard to the following company, which experienced these changes during a period of somewhat over 10 years:

[3]B. C. Churchill, "Age and Life Expectancy of Business Firms," Survey of Current Business, Vol. 35, No. 12, December 1955.

[4]Roberts and Wainer, op cit, p. 80.

Exhibit VII-4

DEPARTURE OF FOUNDERS FROM INDEPENDENT FIRMS

Year of Founding	1960	1961	1962	1963	1964	1965	1966	Total
Number of Firms Founded by Multiple Founders	9	14	11	9	9	5	13	70
Number of Multiple Founder Firms Still in Existence And Independent	3	7	7	6	7	4	12	46
Number of Independent Multiple-Founder Firms With Founding Group Intact	1	2	5	3	3	1	9	24
Percentage of Independent Multiple-Founder Firms With Founding Group Intact	33%	29%	71%	50%	42%	25%	75%	52%

"Smith Electronics" was acquired by an eastern company which renamed it and operated it as an independent subsidiary. Subsequently, this subsidiary was sold to another firm and renamed again. One of the divisions of the firm was then sold to a midwestern company and set up as an independent subsidiary with another name. When the midwestern company was itself acquired, this subsidiary was unwanted. A new corporation was set up, in part by a man who had been a key executive of the firm, and this new corporation bought the subsidiary and renamed it again.

CONCLUSION

The average number of firms founded annually was somewhat higher in the later years of the decade than in the earlier years. However, the birth-rate of such firms, taking into account the growth in regional employment, showed no marked increase.

Once established, the NTBF's appeared to have a low failure rate, in the sense of outright liquidation. However, in other ways they were quite volatile, often being acquired or enduring the break-up of founding teams.

CHAPTER VIII

Conclusions And Implications

Based upon this study of new firms founded in Palo Alto, can we explain how a particular individual founds a firm at a particular time and place?

Clearly, the individual is the starting point. New firms are started not by impersonal processes, but by men who choose to take this step. But, why do some individuals become entrepreneurs, and not others?

The processes influencing the individual entrepreneur are many and complex, yet certain events and influences appear to be important. To start at the beginning, of all those born at a given time, some may be more qualified than others for genetic reasons, inasmuch as technical entrepreneurship seems to require above average intelligence and energy levels. Childhood experiences undoubtedly exert an influence. For instance, it appears that those who have a childhood model - a father in business for himself - are more likely later to become founders. Children who have an orientation toward science and mathematics clearly are more likely to become *technical* entrepreneurs.

The population of potential technical entrepreneurs narrows substantially as educational decisions are made. Unless a person chooses to go to college and unless he chooses to study engineering or the physical sciences, he is unlikely to have the technical background necessary. Even among all engineering or science students, some are more likely to have the psychological characteristics, energy level, technical mastery, and personal goals which may later culminate in entrepreneurship.

All of the engineers and science students with a possible orientation toward entrepreneurship do not become founders. Career decisions to join particular firms are important. The organization which any given engineer joins initially and other organizations which he may move to later on become successive educational institutions. His professional experiences may or may not enable him to develop the technical, managerial, and market knowledge which could later be capitalized upon in a new firm. Some possible entrepreneurs follow career paths in which their personal experience is narrow, or in which they do not have the opportunity to have close contact with colleagues in other functional areas with whom they might form founding teams. An important factor is motivation, including the extent to which potential founders achieve satisfaction, or endure frustration in their work for established organizations. For most men, it is difficult to leave the "warm bed" of a secure and satisfying position; events must occur within the incubator firm which make them determined to make a change, despite the risks and effort involved.

Many potential technical entrepreneurs work in geographical regions where there has been little past entrepreneurship. Even if they have the motivation and the capabilities, it is difficult for entrepreneurship to take root in such an environment. In such a community, the prospective founder sees few models for the kind of behavior he is considering; there are no experienced and successful entrepreneurs

from whom to seek advice and reassurance; contact with experienced sources of venture capital may be elusive and frustrating. Some possible entrepreneurs quit jobs with no specific plans for the future, but are located in communities where it is not easy to achieve self-support through consulting, while deciding what to do next. Under such conditions, the possible founder faced with supporting a family must take a job and make a commitment to another organization, with the consequence that the half-formed idea about founding a new company rarely develops in competition with the duties and loyalties associated with the new position.

Many potential technical entrepreneurs, if they ever take the step of starting their own businesses, do so when they are in their thirties. It is in this age and experience range that most men have significant experience to draw upon, as well as the youthful vigor and willingness to take risks which are necessary. Thus, for many potential entrepreneurs, the conditions which exist when they are in this period of their careers are critical. The conditions within the established organizations for which they *then* work and the regional influences where they are *then* located may determine whether they take this step at all.

Overall conditions relating to the nature of the economy and the availability of venture capital may favor some generations of potential entrepreneurs more than others. Those men in the prime entrepreneurial age who find themselves in an industry with declining fortunes or with a stock market which has just "gone sour" on new issues by NTBF's may miss their chance. By contrast, others may find themselves in the right place at the right time, with mastery of technical and market knowledge about some exploding new technology and with sources of capital literally thrusting money upon them.

The various influences upon the entrepreneurial decision are summarized in Exhibit VIII-1.

IMPLICATIONS FOR ESTABLISHED FIRMS

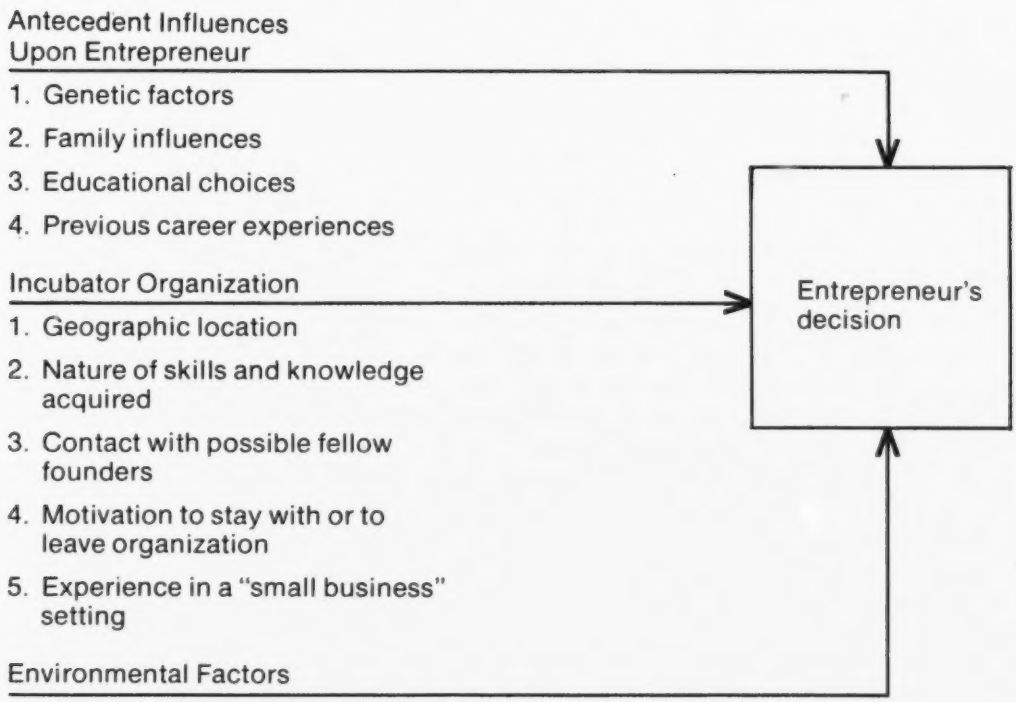
Although this study is primarily about the starting of new firms, there are important implications for executives of the established firms from which the entrepreneurs come.

Many spin-off firms are highly successful and, to the dismay of management, draw off the very kinds of dynamic, entrepreneurial people which the established firms would like to keep.

Some executives may be inclined to bemoan the loss of good people, but to believe that conditions beyond their control are largely responsible. For instance, they may believe that if you are in the semiconductor industry in Palo Alto during the 1960's, you are going to have some spin-offs. To some extent this may be true. However, the findings reported in Chapter V demonstrate that, even in a region of active entrepreneurship such as Palo Alto, there are wide variations in spin-off rates. Within a given industry, some firms function as incubators to a much greater exent than others.

Exhibit VIII-1

INFLUENCES UPON THE ENTREPRENEURIAL DECISION


Antecedent Influences Upon Entrepreneur
1. Genetic factors
2. Family influences
3. Educational choices
4. Previous career experiences
Incubator Organization
1. Geographic location
2. Nature of skills and knowledge acquired
3. Contact with possible fellow founders
4. Motivation to stay with or to leave organization
5. Experience in a "small business" setting
Environmental Factors
1. Economic conditions
2. Accessibility and availability of venture capital
3. Examples of entrepreneurial action
4. Opportunities for interim consulting
5. Availability of personnel and supporting services; accessibility of customers.
Entrepreneur's decision

Interviews with founders suggest that, if a firm has a flurry of spin-offs, there is usually something wrong. It is often an indication of considerable frustration, at least among those who have departed.

What might an established firm do to decrease its spin-off rate? This objective may be elusive for two reasons. One is that certain organizational characteristics which seem to have an influence are not easily changed. The second is that some of the actions which give promise of decreasing spin-offs might, in some circumstances, make the organization less dynamic and less profitable. Organizational attributes which may be associated with a high or low spin-off rate are summarized in Exhibit VIII-2. Some specific proposals which seem likely to decrease spin-off rates are examined below.

1. Change the hiring policies. Spin-offs appear to be a reflection, in part, of the kinds of people being hired. Screening methods could probably be developed to lessen reliance upon people who are likely to leave and become entrepreneurs. The problem is that entrepreneurially oriented people may be very valuable to an organization. The man who might start his won firm some day might be highly suited to starting a new department or to making it grow. Some of the executives interviewed commented that they see some spin-offs as a good thing: an indication that their firms are hiring the right kind of people.

2. Change the organizational structure and the typical pattern of career development. Spin-off rates appear to be highest in small firms and in departments organized as "small businesses" within large firms. Broad experience seems valuable to the entrepreneur. A functional form of organization, rather than a product-decentralized form of organization, seems likely to give fewer technical managers the broad experience of working in a small management group responsible for a product line.[1] Although such an organization might lessen executive satisfaction and thus increase the urge to spin off, it would probably lessen the capability of doing so. However, the problem with this recommendation is that decisions about organizational structure and the breadth of experience which executives acquire must be based upon many considerations. It may be desirable to organize on a product-decentralized basis to provide for greater flexibility, greater innovation, and better executive development. Narrowly trained managers may be less likely to become entrepreneurs, but they may also be less able to produce profits for their organization.

3. Concentrate upon products and markets which cannot easily be exploited by new firms. Many of the firms studied which had high spin-off rates were in industries which were attractive to new firms. Their employees were acquiring knowledge and skills which could be applied directly in new enterprises. Company strategies

[1]One entrepreneur had chosen to organize his own firm on a functional basis because he thought it would lessen spin-offs.

Exhibit VIII-2

INDUSTRY AND ORGANIZATIONAL ATTRIBUTES
RELATED TO THE BIRTH-RATE OF NEW FIRMS

Characteristics of Industry

Low Birth-Rate	High Birth-Rate
slow industry growth	rapid industry growth
slow technological change	rapid technological change
heavy capital investment required	low capital investment required
substantial economies of scale	minor economies of scale

Characteristics of Established Incubator Organizations

Low Birth-Rate	High Birth-Rate
large number of employees	small number of employees
functional organization	product-decentralized organization
recruit average technical people	recruit very capable, ambitious people
relatively well-managed	afflicted with periodic crises
located in isolated area of little entrepreneurship	located in area of high entrepreneurship

There is no suggestion that all of the attributes in a given column are necessarily found together or are required to bring about a given spin-off rate. Various combinations may exist.

involving commitment to fields requiring large investment, large organizations and involving substantial economies of scale seem likely to result in fewer spin-offs.

The problem, of course, is that company strategy decisions cannot be influenced solely or even primarily by spin-off considerations. Fields of rapid growth and change are attractive to established firms, yet, in many instances, are the very fields in which new firms can compete most effectively. A firm making steam radiators may avoid spin-offs, but may also also find profits to be elusive.

4. Locate in a geographical area which has had little technical entrepreneurship. There appear to be feed-back processes, such that past entrepreneurship makes future entrepreneurship more likely. Other factors being equal, a facility located where here has been little past entrepreneurship is likely to have fewer spin-offs. A firm's headquarters or principal facilities may not be moved easily, regardless of spin-off considerations. However, new facilities might be located with this as one factor in mind.

5. Seek to reduce causes of frustration among technical personnel. Since most founders seem driven from their previous positions by frustration, identification of specific causes of frustration and action to remedy these seems a promising area for management concentration.

   In Palo Alto organizations, major causes of frustration centered upon decisions about investment in products and technologies and decisions about placing people in positions of responsibility. In rapidly growing, technologically-oriented firms, these decisions occur frequently, and are of great importance. If they are made poorly, the organization may appear to have a dismal future.

   The answer cannot be to support all proposals or to promote all aspiring managers. In fact, many of the entrepreneurs' frustrations were rooted not in personal disappointments, but in a feeling that projects were being supported and individuals being promoted who did not deserve this support. Improvement in management decision-making in these key areas may lead to a substantial pay-off in lower spin-off rates.

6. Under some circumstances, management of the established organization might consider the radical proposal of supporting spin-offs, rather than trying to prevent them.

   Some technical managers may be determined to start their own firms. Some possible applications of the parent firm's technology lie outside its fields of major interest. Some product-market opportunities might better be exploited by a small firm.

In such situations, if the parent firm were to assist the entrepreneurs, possibly even serving as a source of venture capital, the new firm might be brought smoothly into being and the parent firm might benefit as an investor and through an association with a dynamic new firm.

Of course, it can be argued that too many employees would wish to become entrepreneurs and that this sponsorship might lead to the creation of potential competitors (even though the new firms presumably would not be directly competitive initially). In fact, several firms in the Palo Alto area have provided varying degrees of assistance to entrepreneurs who have spun off from them.

IMPLICATIONS FOR PROSPECTIVE ENTREPRENEURS

What are the implications of the Palo Alto experience for the man who hopes to participate in the founding of an NTBF some day? In approaching this question, it must be recognized that most founders do not seem to undertake a planned series of jobs and experiences which will bring them systematically to the threshold of entrepreneurship. One might suppose that the would-be-founder with a determination to be well-prepared would say something like the following:

> *"I plan to start my own business in the semiconductor field in about ten years. However, first I'll work for five years for the "X" firm in product development, and then I'll work for about five years in manufacturing, possibly for the "Y" firm."*

It does not seem to be that systematic or preplanned. Most jobs appear to be taken with some expectation of permanence, or at least a "we'll wait and see what develops" attitude. Specific opportunities which a new firm might exploit are rarely perceived much in advance. Later, as opportunities develop and are perceived, and as frustrations in a particular organization increase, the founder moves to act — typically with specific plans being developed in a period of months, rather than years.

We can take note of these typical career patterns while, at the same time, pointing out that the man with a long-term goal of becoming a technical entrepreneur might make intermediate career decisions which increase the probability of his eventually being able to start his own firm.

1. Established organizations serve as schools, possibly training for entrepreneurship. The would-be-entrepreneur should take a position with an organization which promises to be a good incubator. Some of the characteristics of such an organization are described in Exhibit VIII-2. Within established firms, the aspiring founder might systematically seek broad personal experience and involvement in promising newer technologies.
2. The aspiring entrepreneur should locate in an area of active entrepreneurship. He will find it easier to start a company in an entrepreneurial environment.

3. The prospective founder might begin to acquire knowledge systematically about sources of capital, marketing practices, possible suppliers, etc. The starting of a new firm is, to a great extent, the establishing of relationships with various parties — including co-founders, investors, customers, and suppliers. Detailed knowledge and a network of relationships can be useful in the appraisal of specific opportunities, as well as in getting the new firm started.

IMPLICATIONS FOR REGIONAL ECONOMIC DEVELOPMENT

Many communities would like their own versions of Boston's Route #128. Although this goal may be unfeasible for many regions, the Palo Alto experience suggests a number of factors essential for developing and nurturing regional technical entrepreneurship:

1. The nature of the established organizations already in a region may well be the most important single factor influencing entrepreneurship. Unless a region posesses promising incubators, or can attract or develop them, other goals for regional economic development should be sought.

   It is interesting to speculate about whether a region could develop, possibly under university auspices, a self-supporting incubator organization, which would have as one of its objectives the nurturing of technical entrepreneurs. Such an organization would have to be involved in developing technologies which give promise of having commercial application. It would have to be successful in attracting very good professional people. It would be desirable if the organization could be involved in some marketing and possibly even manufacturing activities, so that skills and knowledge in these areas might be developed. There might be two kinds of people within the organization. One would be full-time employees, possibly having joined the organization without any clear expectation of becoming entrepreneurs. A second would be aspiring entrepreneurs, who had perhaps quit previous jobs, but had not yet developed specific plans relating to the founding of a firm. The latter group might be employed on a part-time basis, while devoting the rest of their time to the investigation and development of plans relating to their entrepreneurial ideas. There might be some founders just getting started, not employed at all by the organization, who utilized certain facilities and drew upon certain services while paying fees for this support.

   Clearly, one can foresee difficulties with these proposals, most notably in trying to make the organization self-supporting. There also would be questions relating to conflict of interest and competition with

established firms. The author sees no easy answers to these problems, but believes that entrepreneurship is most likely to be nurtured by the presence of incubator organizations with particular characteristics. In the past, some organizations have proved to be good incubators, more by accident than by design. Is it possible to develop a self-supporting organization, which would be judged to be successful if it has a high spin-off rate of successful new firms?

2. As previously discussed, past entrepreneurship develops an environment which makes future foundings more likely. What can be done in a region to create some of the features of an entrepreneurial environment?

   In an area where there has been little past entrepreneurship,, potential founders often do not know of others who have done this; they have no models for this kind of behavior, and the idea of starting a firm may seem foreign to them and to their associates. An additional problem is that, under such conditions, their experience is likely to be in established, often large, firms. They lack knowledge of what is involved in managing small firms and they do not have access to experienced technical entrepreneurs who can give them advice.

   Courses (or possibly short conferences) on entrepreneurship, offered at night or on weekends and aimed at the prospective technical entrepreneur, might alleviate some of these problems. The author believes, based upon personal experience as a teacher, that such courses can serve to teach skills and knowledge relating not only to administration in general, but also to the special problems associated with starting and managing a new firm. Such courses also can influence attitudes and perceptions relating to the fluence attitudes and perceptions relating to the feasibility of entrepreneurship. Outside speakers who are successful entrepreneurs, as well as cases about the founding of new, technologically-based firms, can provide a background of experience, such that entrepreneurship seems less foreign and more realizable.

   The entrepreneurial environment appears to offer a number of advantages to the prospective founder wanting to raise funds. These include well-developed communication networks to bring founders and investors together, local sources experienced in appraising NTBF's and investing in them, and local wealth created by past investment or stock option participation in successful NTBF's.

The creation of local venture capital firms, with the particular goal of assisting NTBF's, might be feasible in some areas; they might participate in the Small Business Investment Company program. There are difficulties in such a proposal. It can be pointed out that most SBIC's have not been very active, and most have not invested in NTBF's. There must be qualified personnel with competence in appraising and assisting NTBF's. In many regions, such qualified personnel are not to be found or are not available for this purpose. In other instances, the amount of entrepreneurship seems insufficient to justify supporting a staff.

Possibly, a more modest and realistic proposal is to create communication networks whereby local technical entrepreneurs might find it easier to make contact with experienced investors in NTBF's located in other areas. Perhaps, particular individuals in universities or financial institutions might train themselves for this role, including the acquisition of a good understanding of the investment goals and preference of particular venture capital sources. There are obvious problems with this proposal, including the difficulty of acquiring such skills and knowledge, particularly in a region where few entrepreneurs come forth. However, methods of facilitating contact between prospective founders and those experienced in investing in and assisting NTBF's may pay large dividends.